Appendix D

Radionuclide Results for Core Samples

Field Sample Number	Lab Sample Number	SDG Number	COC Number	TOS/SOW Number	Lab Code	Type of Location	Location	Depth	Compound	Sample Result	Sample Error	Result Qualifier	Validation Flag	Sample Units	Date Sample Collected	MDA	L&V Report Number
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Antimony-125	-0.0084	0.0181		U	PCI/G	11/05/2003	6.30E-02	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Antimony-125	-0.0162	0.0170		U	PCI/G	11/05/2003	5.68E-02	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Antimony-125	0.0092	0.0261		U	PCI/G	11/05/2003	9.51E-02	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Antimony-125	-0.0183	0.0221		U	PCI/G	11/05/2003	8.05E-02	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Antimony-125	0.0323	0.0157		UJ	PCI/G	11/05/2003	6.20E-02	SOS-TL002-04
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Antimony-125	0.0052	0.0150		U	PCI/G	11/05/2003	5.60E-02	SOS-TL002-04
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Antimony-125	-0.0314	0.0159		U	PCI/G	11/05/2003	4.97E-02	SOS-TL002-04
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Antimony-125	0.0351	0.0182		U	PCI/G	11/05/2003	7.11E-02	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Antimony-125	-0.0092	0.0196		U	PCI/G	11/05/2003	7.10E-02	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Antimony-125	0.0125	0.0168		U	PCI/G	11/05/2003	6.03E-02	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Antimony-125	0.0121	0.0186		U	PCI/G	11/05/2003	6.58E-02	SOS-TL002-04
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Cerium-144	0.0542	0.0402		U	PCI/G	11/05/2003	1.45E-01	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Cerium-144	-0.0235	0.0359		U	PCI/G	11/05/2003	1.30E-01	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Cerium-144	-0.0093	0.0591		U	PCI/G	11/05/2003	2.10E-01	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Cerium-144	-0.0927	0.0522		U	PCI/G	11/05/2003	1.88E-01	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Cerium-144	0.0175	0.0334		U	PCI/G	11/05/2003	1.23E-01	SOS-TL002-04
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Cerium-144	0.0192	0.0294		U	PCI/G	11/05/2003	1.10E-01	SOS-TL002-04
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Cerium-144	0.0001	0.0333		U	PCI/G	11/05/2003	1.10E-01	SOS-TL002-04
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Cerium-144	-0.0533	0.0448		U	PCI/G	11/05/2003	1.65E-01	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Cerium-144	0.0725	0.0481		U	PCI/G	11/05/2003	1.77E-01	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Cerium-144	-0.0188	0.0285		U	PCI/G	11/05/2003	1.05E-01	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Cerium-144	0.0346	0.0465		U	PCI/G	11/05/2003	1.66E-01	SOS-TL002-04
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Cesium-134	0.0180	0.0081		UJ	PCI/G	11/05/2003	3.20E-02	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Cesium-134	0.0106	0.0072		U	PCI/G	11/05/2003	2.86E-02	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Cesium-134	0.0658	0.0214		UJ	PCI/G	11/05/2003	5.47E-02	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Cesium-134	0.0772	0.0172		UJ	PCI/G	11/05/2003	4.64E-02	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Cesium-134	0.0262	0.0071		UJ	PCI/G	11/05/2003	2.87E-02	SOS-TL002-04
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Cesium-134	0.0015	0.0084		U	PCI/G	11/05/2003	2.77E-02	SOS-TL002-04
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Cesium-134	0.0041	0.0073		U	PCI/G	11/05/2003	2.76E-02	SOS-TL002-04
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Cesium-134	0.0071	0.0070		U	PCI/G	11/05/2003	2.77E-02	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Cesium-134	0.0403	0.0182		UJ	PCI/G	11/05/2003	3.99E-02	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Cesium-134	0.0131	0.0078		U	PCI/G	11/05/2003	3.03E-02	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Cesium-134	0.0449	0.0142		UJ	PCI/G	11/05/2003	3.67E-02	SOS-TL002-04
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Cesium-137	-0.0043	0.0070		U	PCI/G	11/05/2003	2.51E-02	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Cesium-137	-0.0003	0.0069		U	PCI/G	11/05/2003	2.55E-02	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Cesium-137	0.0103	0.0119		U	PCI/G	11/05/2003	4.28E-02	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Cesium-137	-0.0173	0.0093		U	PCI/G	11/05/2003	3.14E-02	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Cesium-137	-0.0044	0.0062		U	PCI/G	11/05/2003	2.17E-02	SOS-TL002-04
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Cesium-137	0.0027	0.0067		U	PCI/G	11/05/2003	2.46E-02	SOS-TL002-04
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Cesium-137	0.0009	0.0067		U	PCI/G	11/05/2003	2.50E-02	SOS-TL002-04
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Cesium-137	0.0010	0.0067		U	PCI/G	11/05/2003	2.56E-02	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Cesium-137	0.0120	0.0087		U	PCI/G	11/05/2003	3.31E-02	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Cesium-137	-0.0008	0.0068		U	PCI/G	11/05/2003	2.48E-02	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Cesium-137	-0.0137	0.0086		U	PCI/G	11/05/2003	2.49E-02	SOS-TL002-04
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Cobalt-60	0.0026	0.0085		U	PCI/G	11/05/2003	3.17E-02	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Cobalt-60	0.0119	0.0073		U	PCI/G	11/05/2003	3.09E-02	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Cobalt-60	0.0038	0.0108		U	PCI/G	11/05/2003	4.01E-02	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Cobalt-60	-0.0111	0.0101		U	PCI/G	11/05/2003	3.47E-02	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Cobalt-60	0.0061	0.0075		U	PCI/G	11/05/2003	2.64E-02	SOS-TL002-04
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Cobalt-60	-0.0063	0.0070		U	PCI/G	11/05/2003	2.41E-02	SOS-TL002-04
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Cobalt-60	0.0056	0.0070		U	PCI/G	11/05/2003	2.85E-02	SOS-TL002-04
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Cobalt-60	-0.0067	0.0077		U	PCI/G	11/05/2003	2.77E-02	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Cobalt-60	0.0075	0.0084		U	PCI/G	11/05/2003	3.19E-02	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Cobalt-60	-0.0024	0.0082		U	PCI/G	11/05/2003	2.98E-02	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Cobalt-60	0.0028	0.0080		U	PCI/G	11/05/2003	2.88E-02	SOS-TL002-04
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Europium-152	-0.0074	0.0178		U	PCI/G	11/05/2003	6.31E-02	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Europium-152	-0.0014	0.0205		U	PCI/G	11/05/2003	7.18E-02	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Europium-152	0.0109	0.0290		U	PCI/G	11/05/2003	9.96E-02	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Europium-152	-0.0570	0.0258		U	PCI/G	11/05/2003	8.48E-02	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Europium-152	-0.0244	0.0160		U	PCI/G	11/05/2003	5.67E-02	SOS-TL002-04
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Europium-152	-0.0028	0.0156		U	PCI/G	11/05/2003	5.78E-02	SOS-TL002-04
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Europium-152	0.0010	0.0169		U	PCI/G	11/05/2003	6.01E-02	SOS-TL002-04
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Europium-152	-0.0068	0.0200		U	PCI/G	11/05/2003	7.19E-02	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Europium-152	-0.0317	0.0209		U	PCI/G	11/05/2003	7.44E-02	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Europium-152	-0.0323	0.0173		U	PCI/G	11/05/2003	5.64E-02	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Europium-152	0.0237	0.0206		U	PCI/G	11/05/2003	7.43E-02	SOS-TL002-04
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Europium-154	-0.0386	0.0259		U	PCI/G	11/05/2003	7.10E-02	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Europium-154	-0.0050	0.0211		U	PCI/G	11/05/2003	7.88E-02	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Europium-154	0.0062	0.0384		U	PCI/G	11/05/2003	1.38E-01	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Europium-154	0.0042	0.0564		U	PCI/G	11/05/2003	1.19E-01	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Europium-154	0.0185	0.0202		U	PCI/G	11/05/2003	7.92E-02	SOS-TL002-04

Field Sample Number	Lab Sample Number	SDG Number	COC Number	TOS/SOW Number	Lab Code	Type of Location	Location	Depth	Compound	Sample Result	Sample Error	Result Qualifier	Validation Flag	Sample Units	Date Sample Collected	MDA	L&V Report Number
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Europium-154	-0.0115	0.0209		U	PCI/G	11/05/2003	7.37E-02	SOS-TL002-04
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Europium-154	0.0106	0.0184		U	PCI/G	11/05/2003	7.44E-02	SOS-TL002-04
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Europium-154	-0.0004	0.0220		U	PCI/G	11/05/2003	8.06E-02	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Europium-154	0.0203	0.0308		U	PCI/G	11/05/2003	1.00E-01	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Europium-154	0.0134	0.0222		U	PCI/G	11/05/2003	8.50E-02	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Europium-154	-0.0190	0.0253		U	PCI/G	11/05/2003	8.71E-02	SOS-TL002-04
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Europium-155	0.0060	0.0201		U	PCI/G	11/05/2003	7.23E-02	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Europium-155	0.0320	0.0197		U	PCI/G	11/05/2003	7.61E-02	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Europium-155	0.1460	0.0497		UJ	PCI/G	11/05/2003	1.19E-01	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Europium-155	0.0677	0.0271		UJ	PCI/G	11/05/2003	1.06E-01	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Europium-155	0.0094	0.0178		U	PCI/G	11/05/2003	6.61E-02	SOS-TL002-04
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Europium-155	0.0937	0.0367		UJ	PCI/G	11/05/2003	5.85E-02	SOS-TL002-04
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Europium-155	0.0069	0.0168		U	PCI/G	11/05/2003	6.32E-02	SOS-TL002-04
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Europium-155	0.0411	0.0242		U	PCI/G	11/05/2003	9.62E-02	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Europium-155	0.0332	0.0338		U	PCI/G	11/05/2003	9.54E-02	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Europium-155	0.0139	0.0145		U	PCI/G	11/05/2003	5.10E-02	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Europium-155	0.0484	0.0324		U	PCI/G	11/05/2003	8.34E-02	SOS-TL002-04
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Gross Alpha	2.03	0.877		UJ	PCI/G	11/05/2003	3.06E+00	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Gross Alpha	4.61	1.22		J	PCI/G	11/05/2003	3.82E+00	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Gross Alpha	16.2	1.68		J	PCI/G	11/05/2003	2.03E+00	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Gross Alpha	15.5	1.50		J	PCI/G	11/05/2003	2.63E+00	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Gross Alpha	5.55	1.19		J	PCI/G	11/05/2003	3.19E+00	SOS-TL002-04
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Gross Alpha	5.86	1.40		J	PCI/G	11/05/2003	4.41E+00	SOS-TL002-04
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Gross Alpha	5.01	1.44		J	PCI/G	11/05/2003	4.77E+00	SOS-TL002-04
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Gross Alpha	3.52	0.99		J	PCI/G	11/05/2003	2.85E+00	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Gross Alpha	16.7	1.65		J	PCI/G	11/05/2003	1.74E+00	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Gross Alpha	10.9	1.58		J	PCI/G	11/05/2003	2.35E+00	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Gross Alpha	11.50	1.47		J	PCI/G	11/05/2003	2.38E+00	SOS-TL002-04
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Gross Beta	3.61	1.10		J	PCI/G	11/05/2003	4.08E+00	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Gross Beta	9.67	1.38		J	PCI/G	11/05/2003	4.49E+00	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Gross Beta	24.6	1.63		J	PCI/G	11/05/2003	3.80E+00	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Gross Beta	33.0	1.76		J	PCI/G	11/05/2003	3.82E+00	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Gross Beta	7.42	1.26		J	PCI/G	11/05/2003	4.32E+00	SOS-TL002-04
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Gross Beta	8.20	1.33		J	PCI/G	11/05/2003	4.59E+00	SOS-TL002-04
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Gross Beta	7.73	1.41		J	PCI/G	11/05/2003	4.95E+00	SOS-TL002-04
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Gross Beta	5.56	1.17		J	PCI/G	11/05/2003	4.09E+00	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Gross Beta	28.2	1.78		J	PCI/G	11/05/2003	3.46E+00	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Gross Beta	16.4	1.80		J	PCI/G	11/05/2003	3.65E+00	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Gross Beta	20.8	1.89		J	PCI/G	11/05/2003	3.98E+00	SOS-TL002-04
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Manganese-54	-0.0086	0.0070		U	PCI/G	11/05/2003	2.38E-02	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Manganese-54	0.0099	0.0064		U	PCI/G	11/05/2003	2.55E-02	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Manganese-54	0.0121	0.0119		U	PCI/G	11/05/2003	4.15E-02	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Manganese-54	0.0168	0.0176		U	PCI/G	11/05/2003	3.38E-02	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Manganese-54	0.0067	0.0064		U	PCI/G	11/05/2003	2.41E-02	SOS-TL002-04
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Manganese-54	-0.0019	0.0059		U	PCI/G	11/05/2003	2.19E-02	SOS-TL002-04
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Manganese-54	-0.0017	0.0065		U	PCI/G	11/05/2003	2.36E-02	SOS-TL002-04
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Manganese-54	0.0027	0.0061		U	PCI/G	11/05/2003	2.33E-02	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Manganese-54	-0.0023	0.0088		U	PCI/G	11/05/2003	3.05E-02	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Manganese-54	-0.0030	0.0072		U	PCI/G	11/05/2003	2.53E-02	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Manganese-54	0.0114	0.0091		U	PCI/G	11/05/2003	2.87E-02	SOS-TL002-04
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Niobium-95	0.0010	0.0086		U	PCI/G	11/05/2003	3.13E-02	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Niobium-95	0.0105	0.0088		U	PCI/G	11/05/2003	3.36E-02	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Niobium-95	0.0166	0.0168		U	PCI/G	11/05/2003	5.32E-02	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Niobium-95	0.0572	0.0210		UJ	PCI/G	11/05/2003	4.58E-02	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Niobium-95	0.0079	0.0083		U	PCI/G	11/05/2003	3.09E-02	SOS-TL002-04
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Niobium-95	0.0006	0.0088		U	PCI/G	11/05/2003	2.73E-02	SOS-TL002-04
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Niobium-95	0.0127	0.0110		U	PCI/G	11/05/2003	2.88E-02	SOS-TL002-04
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Niobium-95	0.0140	0.0081		U	PCI/G	11/05/2003	3.27E-02	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Niobium-95	-0.0031	0.0173		U	PCI/G	11/05/2003	3.74E-02	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Niobium-95	-0.0034	0.0092		U	PCI/G	11/05/2003	3.24E-02	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Niobium-95	0.0308	0.0108		UJ	PCI/G	11/05/2003	3.56E-02	SOS-TL002-04
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Ruthenium-106	0.0429	0.0632		U	PCI/G	11/05/2003	2.38E-01	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Ruthenium-106	-0.0109	0.0538		U	PCI/G	11/05/2003	1.98E-01	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Ruthenium-106	0.0166	0.0913		U	PCI/G	11/05/2003	3.26E-01	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Ruthenium-106	0.0921	0.0796		U	PCI/G	11/05/2003	2.97E-01	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Ruthenium-106	-0.0618	0.0635		U	PCI/G	11/05/2003	2.19E-01	SOS-TL002-04
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Ruthenium-106	0.0036	0.0532		U	PCI/G	11/05/2003	1.93E-01	SOS-TL002-04

Field Sample Number	Lab Sample Number	SDG Number	COC Number	TOS/SOW Number	Lab Code	Type of Location	Location	Depth	Compound	Sample Result	Sample Error	Result Qualifier	Validation Flag	Sample Units	Date Sample Collected	MDA	L&V Report Number
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Ruthenium-106	0.0554	0.0581		U	PCI/G	11/05/2003	2.24E-01	SOS-TL002-04
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Ruthenium-106	-0.0568	0.0578		U	PCI/G	11/05/2003	2.08E-01	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Ruthenium-106	-0.0008	0.0675		U	PCI/G	11/05/2003	2.42E-01	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Ruthenium-106	-0.0574	0.0667		U	PCI/G	11/05/2003	2.03E-01	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Ruthenium-106	-0.0811	0.0609		U	PCI/G	11/05/2003	2.10E-01	SOS-TL002-04
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Silver-108m	-0.0082	0.0063		U	PCI/G	11/05/2003	2.10E-02	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Silver-108m	-0.0109	0.0068		U	PCI/G	11/05/2003	2.21E-02	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Silver-108m	0.0000	0.0091		U	PCI/G	11/05/2003	3.30E-02	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Silver-108m	0.0107	0.0081		U	PCI/G	11/05/2003	3.10E-02	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Silver-108m	0.0003	0.0055		U	PCI/G	11/05/2003	2.02E-02	SOS-TL002-04
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Silver-108m	0.0049	0.0050		U	PCI/G	11/05/2003	1.91E-02	SOS-TL002-04
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Silver-108m	0.0034	0.0057		U	PCI/G	11/05/2003	2.07E-02	SOS-TL002-04
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Silver-108m	0.0113	0.0074		U	PCI/G	11/05/2003	2.54E-02	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Silver-108m	-0.0123	0.0069		U	PCI/G	11/05/2003	2.41E-02	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Silver-108m	0.0017	0.0064		U	PCI/G	11/05/2003	2.24E-02	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Silver-108m	0.0077	0.0068		U	PCI/G	11/05/2003	2.42E-02	SOS-TL002-04
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Silver-110m	0.0012	0.0063		U	PCI/G	11/05/2003	2.34E-02	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Silver-110m	0.0020	0.0060		U	PCI/G	11/05/2003	2.27E-02	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Silver-110m	-0.0247	0.0104		U	PCI/G	11/05/2003	3.36E-02	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Silver-110m	0.0144	0.0085		U	PCI/G	11/05/2003	3.20E-02	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Silver-110m	0.0013	0.0057		U	PCI/G	11/05/2003	2.11E-02	SOS-TL002-04
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Silver-110m	-0.0096	0.0063		U	PCI/G	11/05/2003	2.08E-02	SOS-TL002-04
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Silver-110m	0.0025	0.0060		U	PCI/G	11/05/2003	2.26E-02	SOS-TL002-04
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Silver-110m	0.0018	0.0067		U	PCI/G	11/05/2003	2.53E-02	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Silver-110m	-0.0008	0.0079		U	PCI/G	11/05/2003	2.48E-02	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Silver-110m	-0.0038	0.0061		U	PCI/G	11/05/2003	2.15E-02	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Silver-110m	0.0099	0.0064		U	PCI/G	11/05/2003	2.28E-02	SOS-TL002-04
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Strontium-90	0.1550	0.0989		U	PCI/G	11/05/2003	3.97E-01	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Strontium-90	0.0586	0.1020		U	PCI/G	11/05/2003	4.40E-01	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Strontium-90	0.1690	0.1050		U	PCI/G	11/05/2003	4.20E-01	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Strontium-90	0.2150	0.1160		U	PCI/G	11/05/2003	4.55E-01	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Strontium-90	0.0382	0.1330		U	PCI/G	11/05/2003	5.73E-01	SOS-TL002-04
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Strontium-90	0.3160	0.1450		UJ	PCI/G	11/05/2003	5.55E-01	SOS-TL002-04
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Strontium-90	0.2080	0.1200		U	PCI/G	11/05/2003	4.71E-01	SOS-TL002-04
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Strontium-90	-0.0036	0.0957		U	PCI/G	11/05/2003	4.26E-01	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Strontium-90	0.1560	0.1180		U	PCI/G	11/05/2003	4.84E-01	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Strontium-90	0.0308	0.0984		U	PCI/G	11/05/2003	4.27E-01	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Strontium-90	0.2400	0.1100		UJ	PCI/G	11/05/2003	4.14E-01	SOS-TL002-04
5OM32601RH	101364003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Technetium-99	-0.0097	0.1590		U	PCI/G	11/05/2003	5.46E-01	SOS-TL008-04
5OM32701RH	101364004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Technetium-99	0.4920	0.2320		UJ	PCI/G	11/05/2003	7.75E-01	SOS-TL008-04
5OM32801RH	101364005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Technetium-99	0.0105	0.1380		U	PCI/G	11/05/2003	4.71E-01	SOS-TL008-04
5OM32901RH	101364006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Technetium-99	-0.0129	0.2110		U	PCI/G	11/05/2003	7.23E-01	SOS-TL008-04
5OM33001RH	101364007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Technetium-99	0.0483	0.1770		U	PCI/G	11/05/2003	6.04E-01	SOS-TL008-04
5OM33101RH	101364008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Technetium-99	-0.3230	0.1510		U	PCI/G	11/05/2003	5.30E-01	SOS-TL008-04
5OM32501RH	101364001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Technetium-99	-0.1100	0.1790		U	PCI/G	11/05/2003	6.17E-01	SOS-TL008-04
5OM32502RH	101364002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Technetium-99	-0.1430	0.1020		U	PCI/G	11/05/2003	3.56E-01	SOS-TL008-04
5OM33201RH	101364009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Technetium-99	-0.0608	0.1130		U	PCI/G	11/05/2003	3.91E-01	SOS-TL008-04
5OM33301RH	101364010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Technetium-99	-0.0628	0.1710		U	PCI/G	11/05/2003	5.89E-01	SOS-TL008-04
5OM33401RH	101364011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Technetium-99	0.0058	0.1280		U	PCI/G	11/05/2003	4.39E-01	SOS-TL008-04
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Uranium-235	0.0832	0.0512		U	PCI/G	11/05/2003	1.54E-01	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Uranium-235	-0.0418	0.0374		U	PCI/G	11/05/2003	1.33E-01	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Uranium-235	0.1210	0.0741		U	PCI/G	11/05/2003	2.27E-01	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Uranium-235	0.0415	0.0553		U	PCI/G	11/05/2003	2.07E-01	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Uranium-235	0.0868	0.0372		UJ	PCI/G	11/05/2003	1.39E-01	SOS-TL002-04
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Uranium-235	0.0396	0.0313		U	PCI/G	11/05/2003	1.17E-01	SOS-TL002-04
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Uranium-235	0.0319	0.0362		U	PCI/G	11/05/2003	1.35E-01	SOS-TL002-04
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Uranium-235	0.0623	0.0458		U	PCI/G	11/05/2003	1.77E-01	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Uranium-235	-0.0154	0.0542		U	PCI/G	11/05/2003	1.73E-01	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Uranium-235	0.0132	0.0311		U	PCI/G	11/05/2003	1.17E-01	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Uranium-235	0.1370	0.0768		U	PCI/G	11/05/2003	1.82E-01	SOS-TL002-04
5OM32601RH	101378003	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	43	Zinc-65	-0.0131	0.0191		U	PCI/G	11/05/2003	5.79E-02	SOS-TL002-04
5OM32701RH	101378004	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	105	Zinc-65	0.0118	0.0147		U	PCI/G	11/05/2003	5.62E-02	SOS-TL002-04
5OM32801RH	101378005	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	155	Zinc-65	0.0369	0.0297		U	PCI/G	11/05/2003	9.93E-02	SOS-TL002-04
5OM32901RH	101378006	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	195	Zinc-65	-0.0484	0.0279		U	PCI/G	11/05/2003	8.01E-02	SOS-TL002-04
5OM33001RH	101378007	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	274	Zinc-65	0.0182	0.0166		U	PCI/G	11/05/2003	5.80E-02	SOS-TL002-04
5OM33101RH	101378008	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	293	Zinc-65	0.0191	0.0137		U	PCI/G	11/05/2003	5.03E-02	SOS-TL002-04
5OM32501RH	101378001	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Zinc-65	-0.0411	0.0213		U	PCI/G	11/05/2003	5.46E-02	SOS-TL002-04

Field Sample Number	Lab Sample Number	SDG Number	COC Number	TOS/SOW Number	Lab Code	Type of Location	Location	Depth	Compound	Sample Result	Sample Error	Result Qualifier	Validation Flag	Sample Units	Date Sample Collected	MDA	L&V Report Number
5OM32502RH	101378002	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-SCI-P-252	305-306	Zinc-65	0.0188	0.0168		U	PCI/G	11/05/2003	5.93E-02	SOS-TL002-04
5OM33201RH	101378009	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	350	Zinc-65	0.0034	0.0287		U	PCI/G	11/05/2003	6.22E-02	SOS-TL002-04
5OM33301RH	101378010	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	377	Zinc-65	0.0211	0.0171		U	PCI/G	11/05/2003	6.05E-02	SOS-TL002-04
5OM33401RH	101378011	5OM32501RH	23624	ER-TOS-A2224	GEL	ARCHIVED CORE	ICPP-MON-A-230	385-387	Zinc-65	-0.0007	0.0210		U	PCI/G	11/05/2003	6.45E-02	SOS-TL002-04

Validation Flags:

J = estimated value.

U = nondetect.

Appendix E

Colloidal Borescope Logging Results for Monitor Well ICPP-MON-A-230

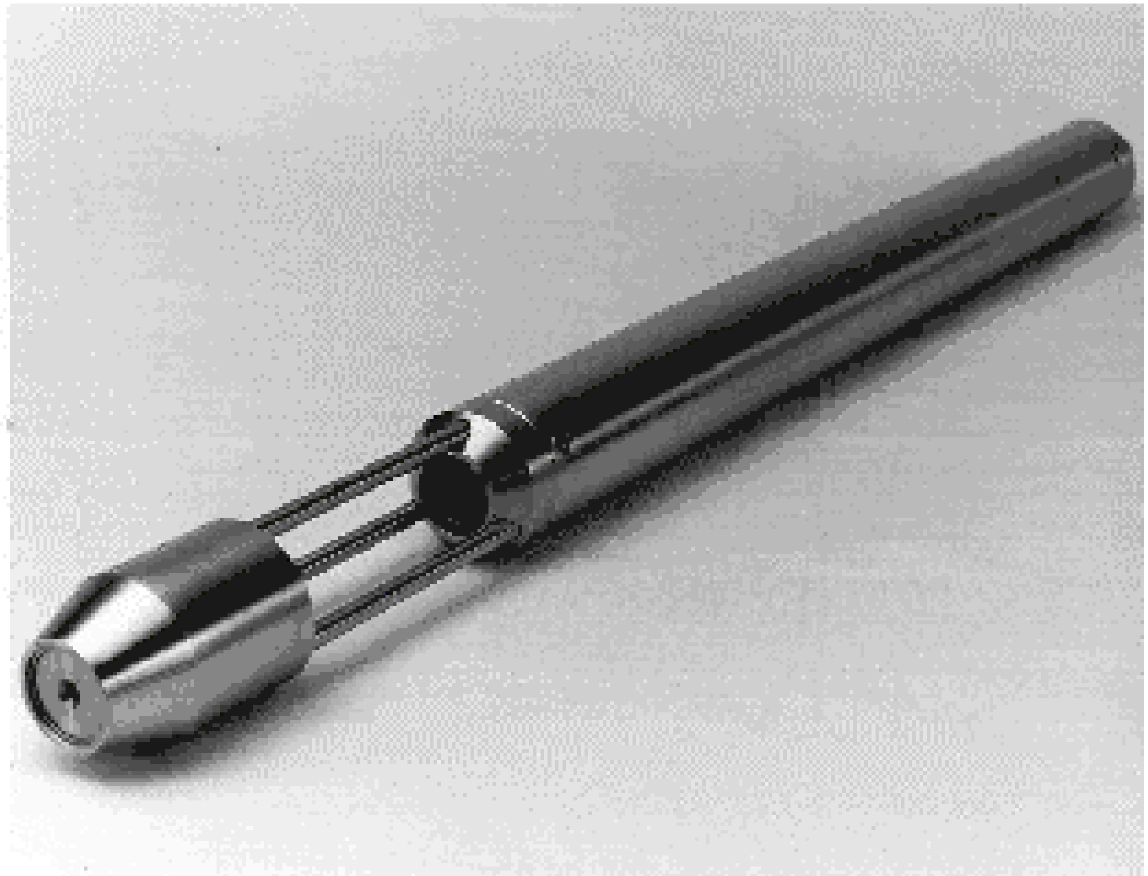
Tc-99 Groundwater Investigation

Colloidal Borescope Data Presentation

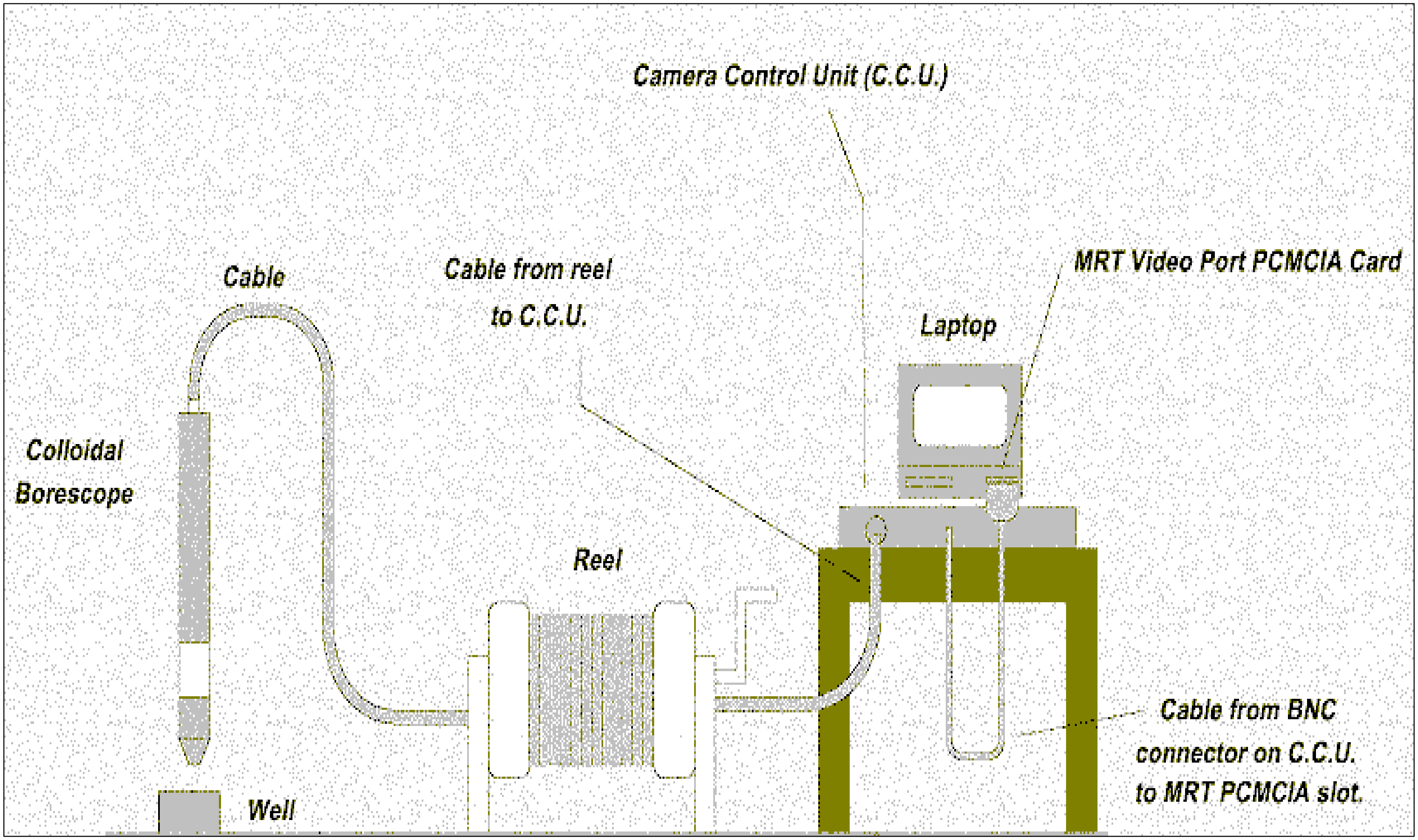
From: Monitoring Well ICCP-MON-A-230
Dates: October 22, 23, 2003

December 2003

Colloidal Borescope



Components


Camera Control Unit (C.C.U.)
MRT Video Port PCMCIA Card
Cable
Cable from reel
to C.C.U.
Laptop
Colloidal
Borescope
Reel
Cable from BNC
connector on C.C.U.
to MRT PCMCIA slot.
Well

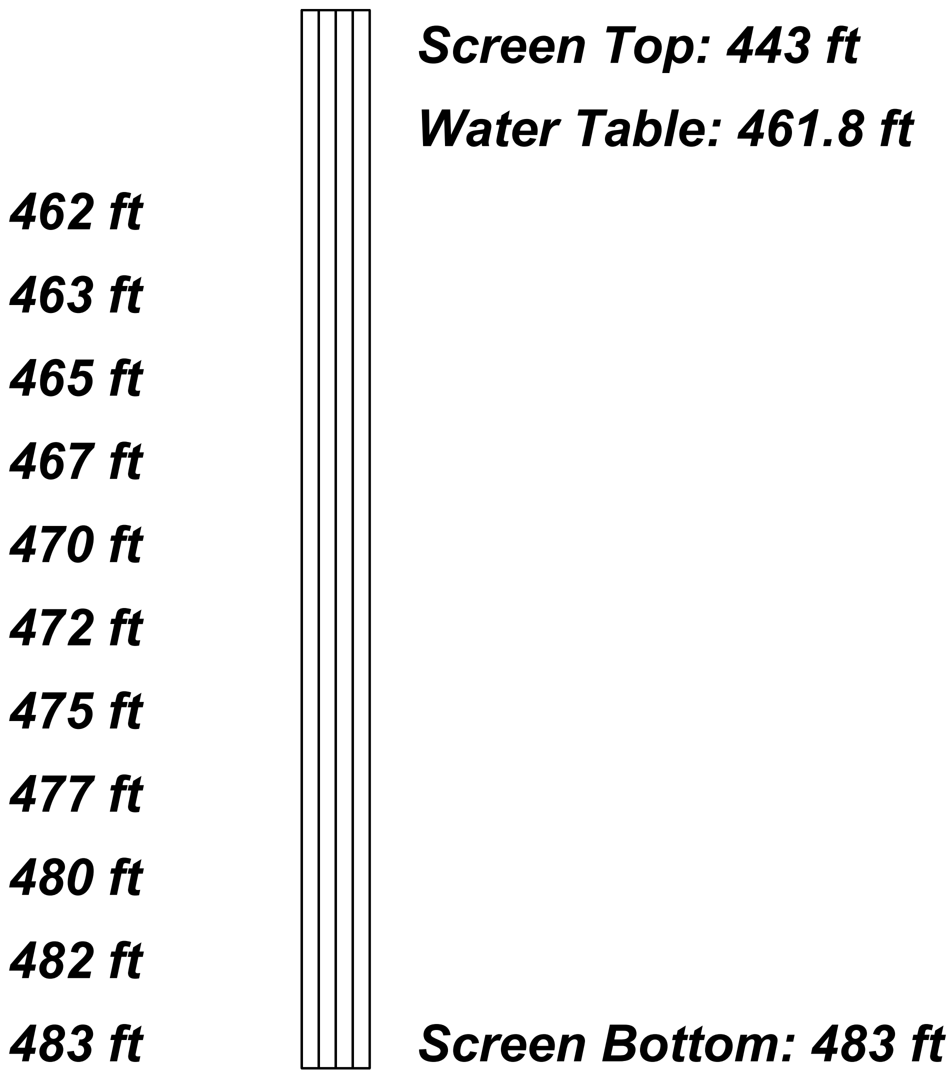
The Technology

The colloidal borescope is a down-hole device that captures visual images of colloidal particles over time and calculates groundwater flow direction based on the observed movement of these particles. In the borehole, groundwater flows past a digital camera that collects digitized images of colloidal particles in the groundwater. Images, collected every few milliseconds, are compared to determine the distance and direction of particle movement during the time interval.

Field Setup

View Inside Van

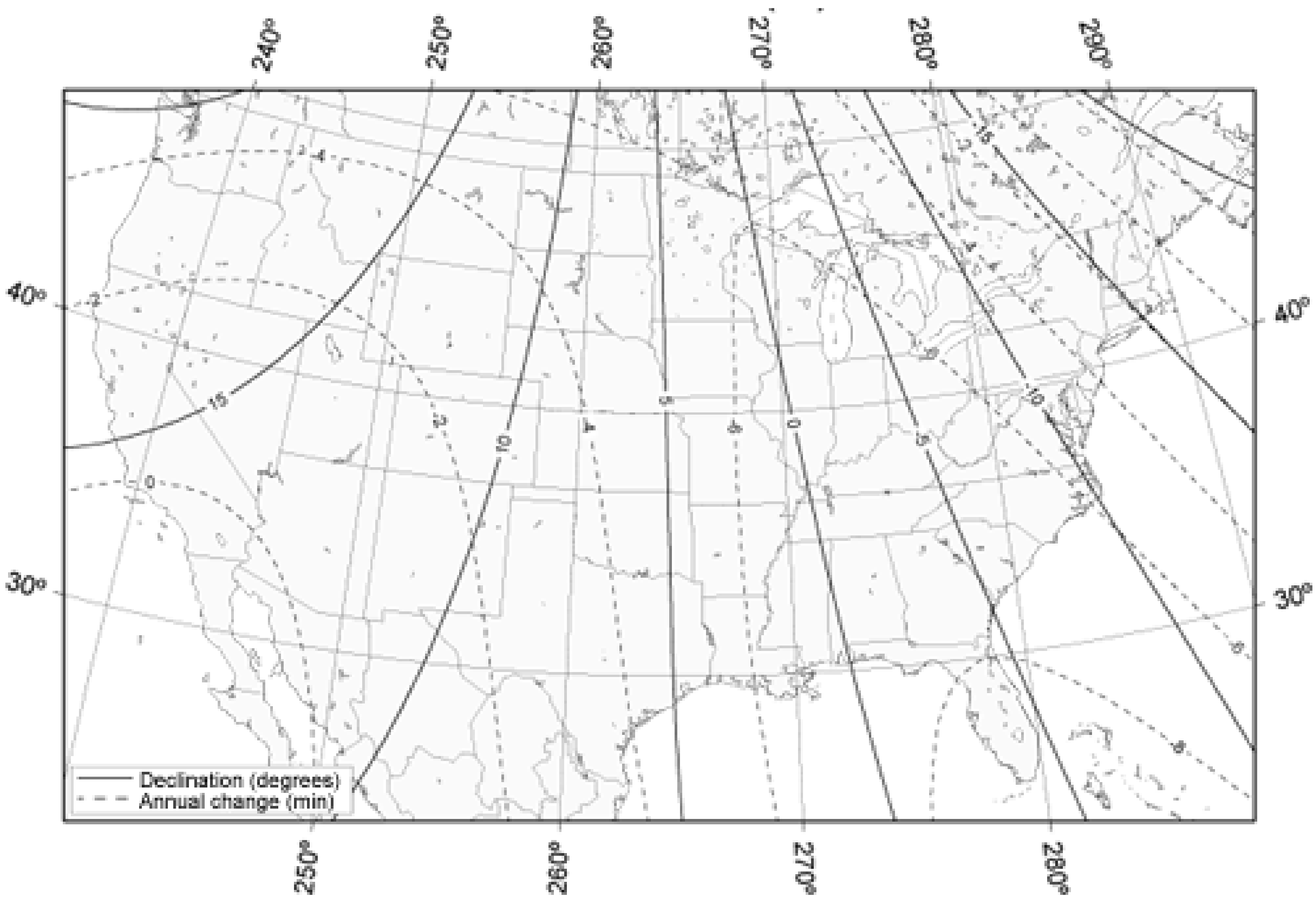
Data Collection Depths BGS



Data Collection Findings BGS

	Screen Top: 443 ft
	Water Table: 461.8 ft
462 ft	Swirling Non-Directional Flow
463 ft	Swirling Non-Directional Flow
465 ft	Swirling Non-Directional Flow
467 ft	Swirling Non-Directional Flow
470 ft	Swirling Non-Directional Flow
472 ft	Swirling Non-Directional Flow
475 ft	Swirling Non-Directional Flow
477 ft	Reliable Flow Zone
480 ft	Swirling Non-Directional Flow
482 ft	Reliable Flow Zone
483 ft	Screen Bottom: 483 ft

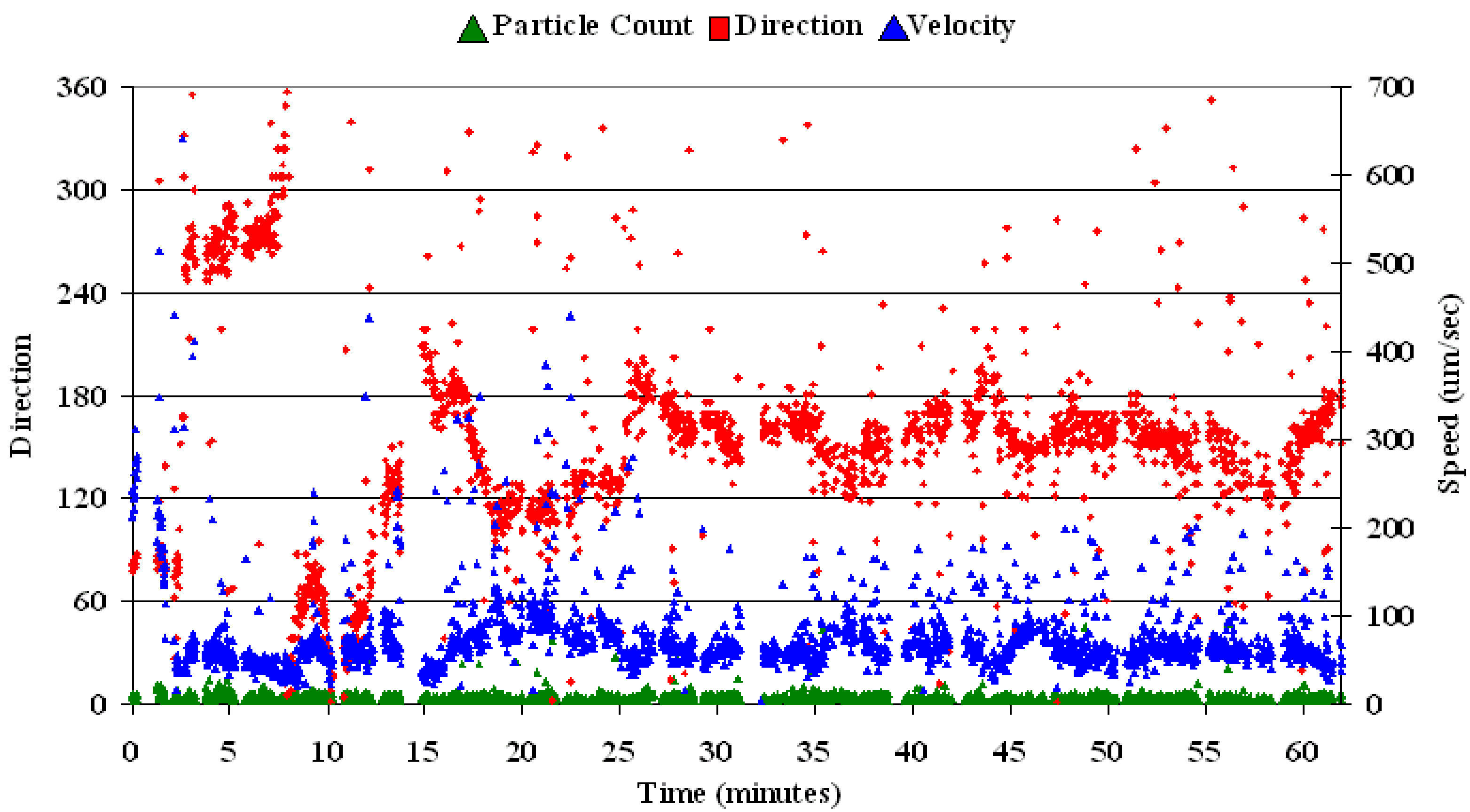
Magnetic Declination (degrees)



Magnetic Declination

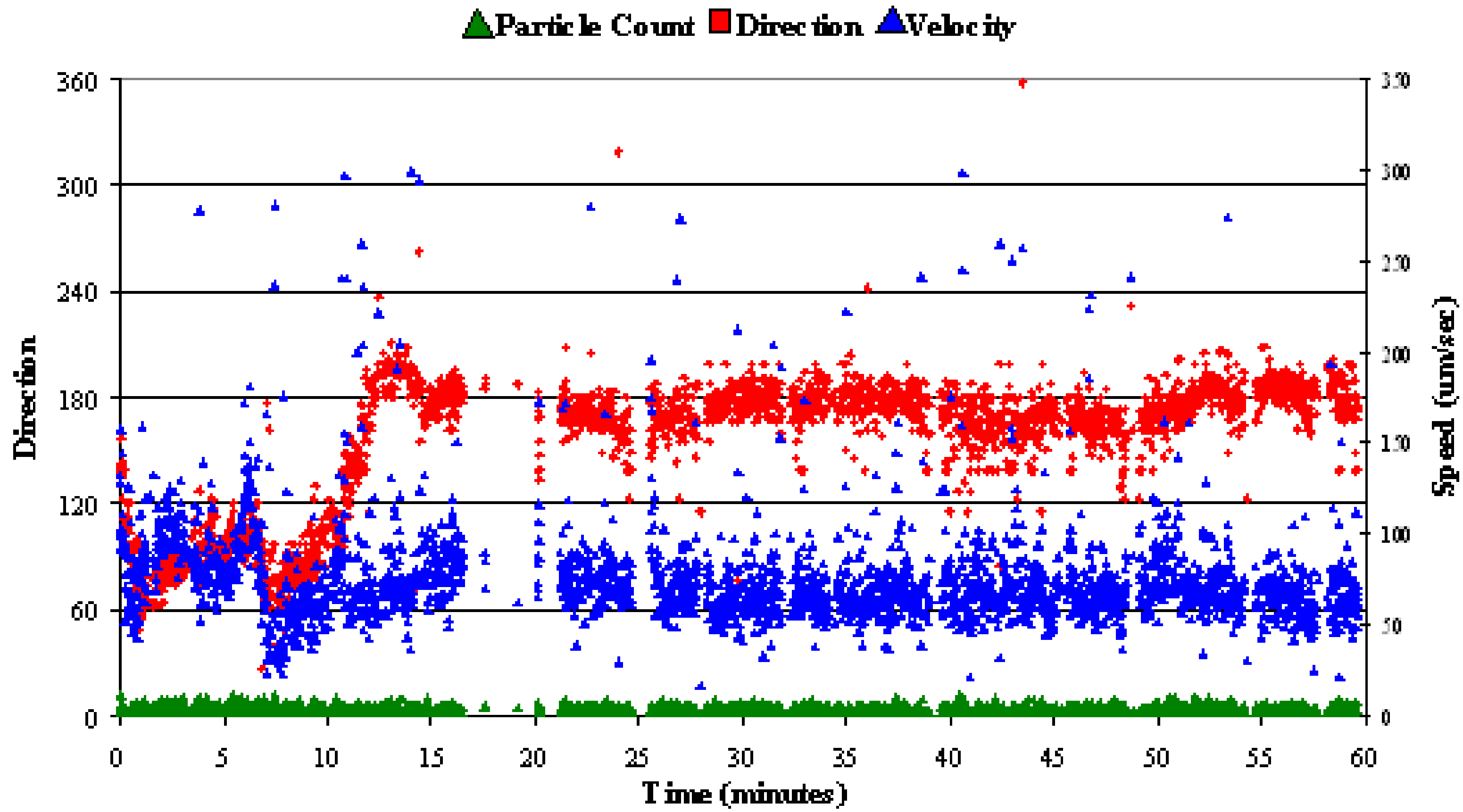
- Latitude 43.50, Longitude -113.00, Elevation 5,000 ft
- On 10/22/2003, the Magnetic Declination was 14 Degrees 25 Minutes East
- The Current Rate of Change is 5 Minutes/Year West
- Magnetic Declination is the Angle Between True North and Magnetic North

Reliable Flow at 477 Ft BGS



Average Direction: 157 - Average Velocity: 45 um/sec - Average Seepage Velocity: 3.22 ft/day

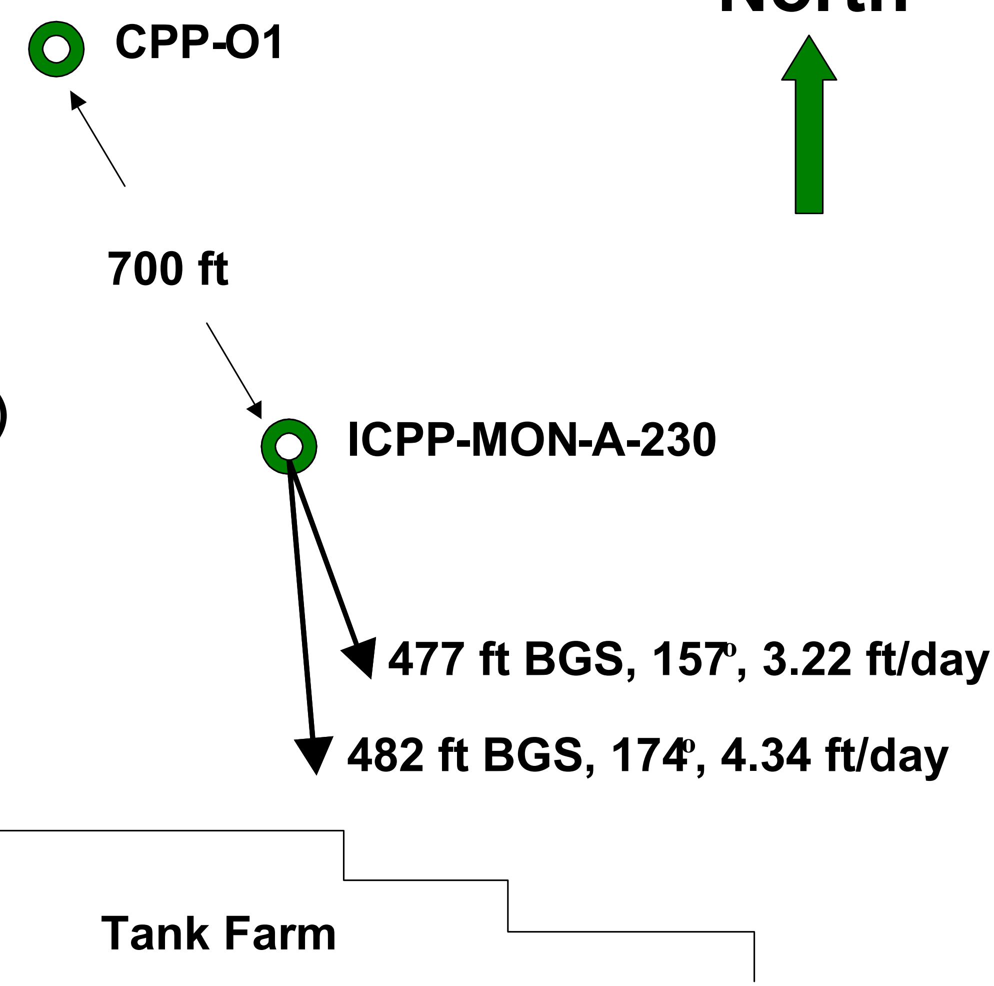
Reliable Flow at 482 Feet BGS



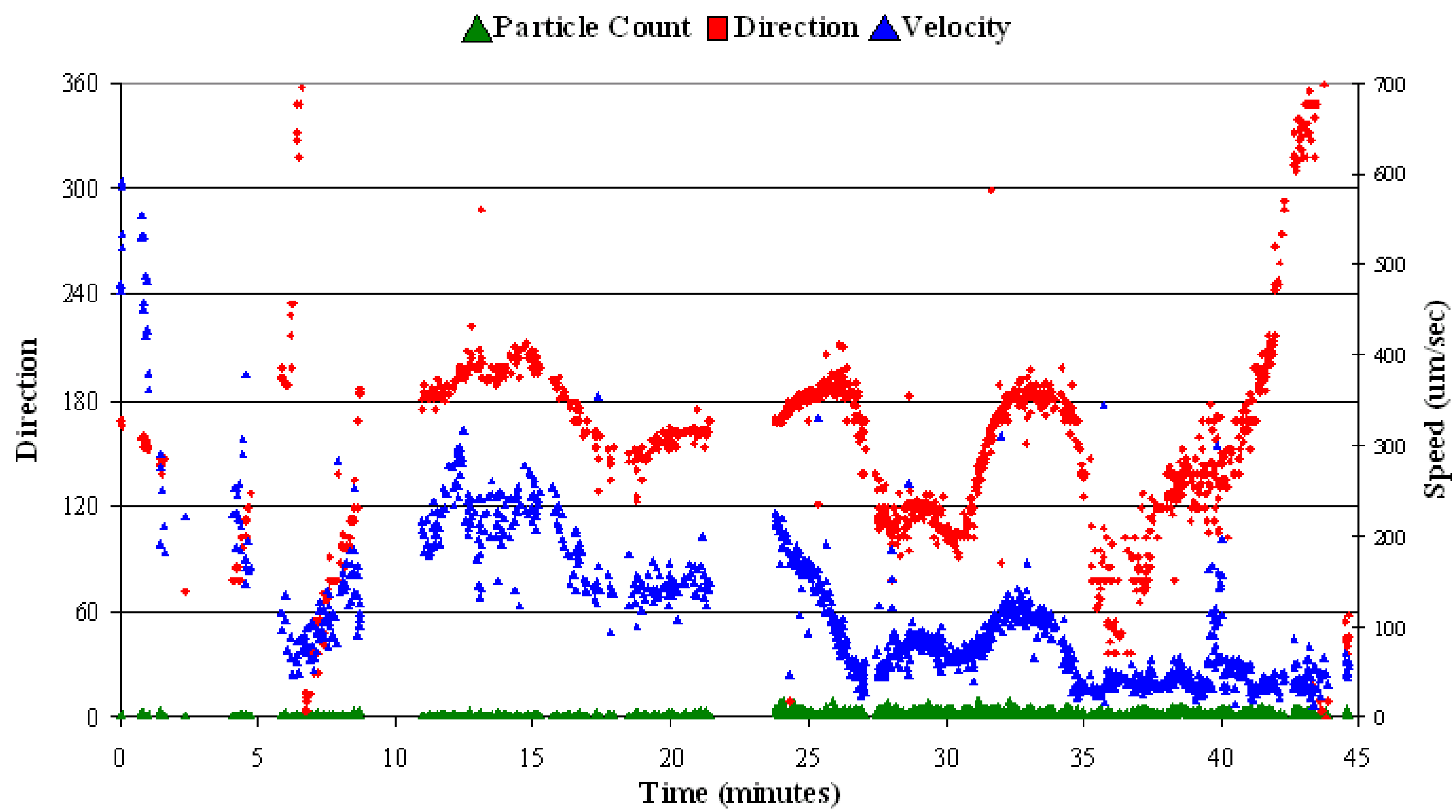
Average Direction: 174 - Average Velocity: 61 um/sec - Average Seepage Velocity: 4.34 ft/day

Plot of Reliable Flow Day 1

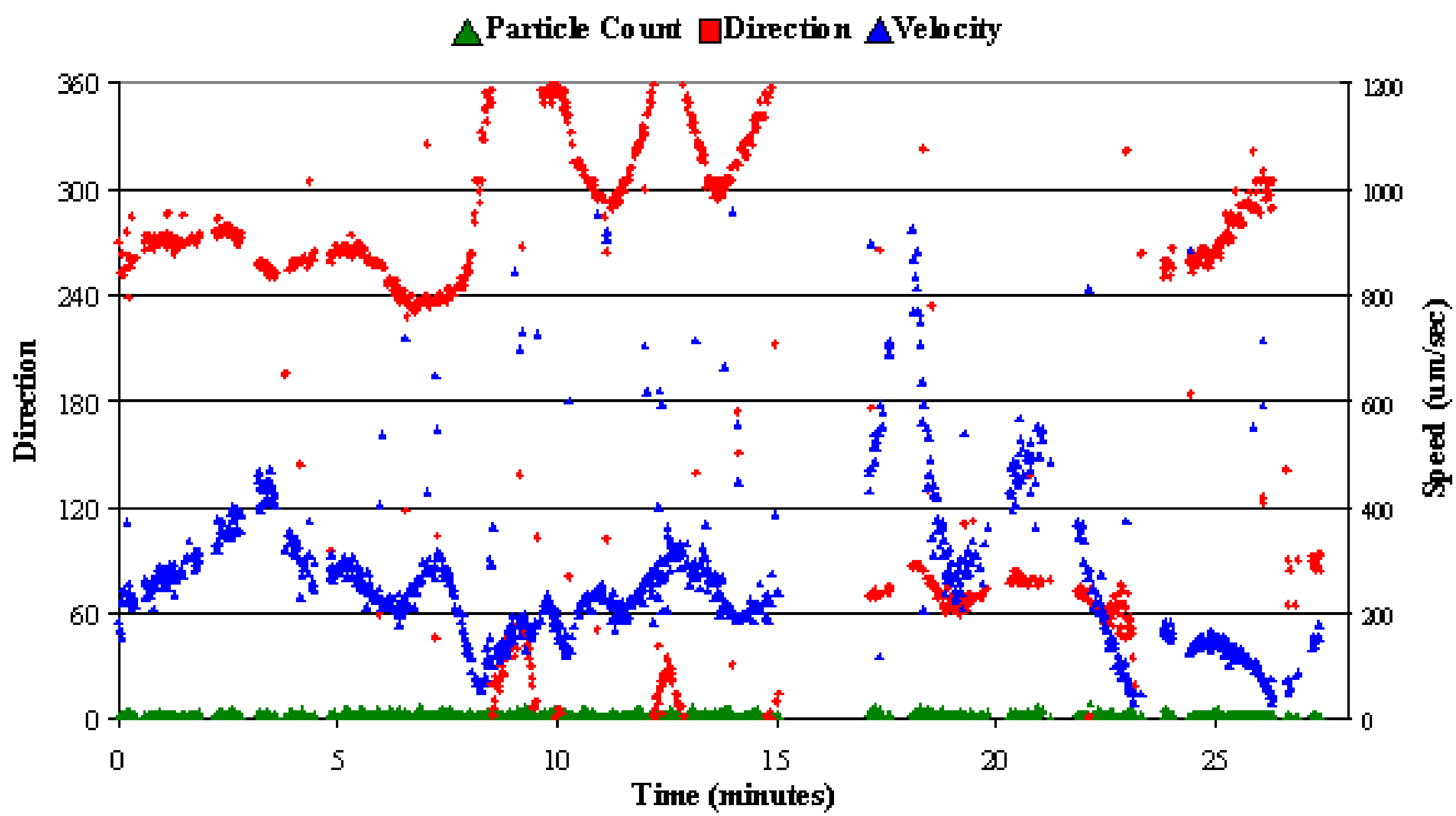
Day 1 (Oct 22, 2003)



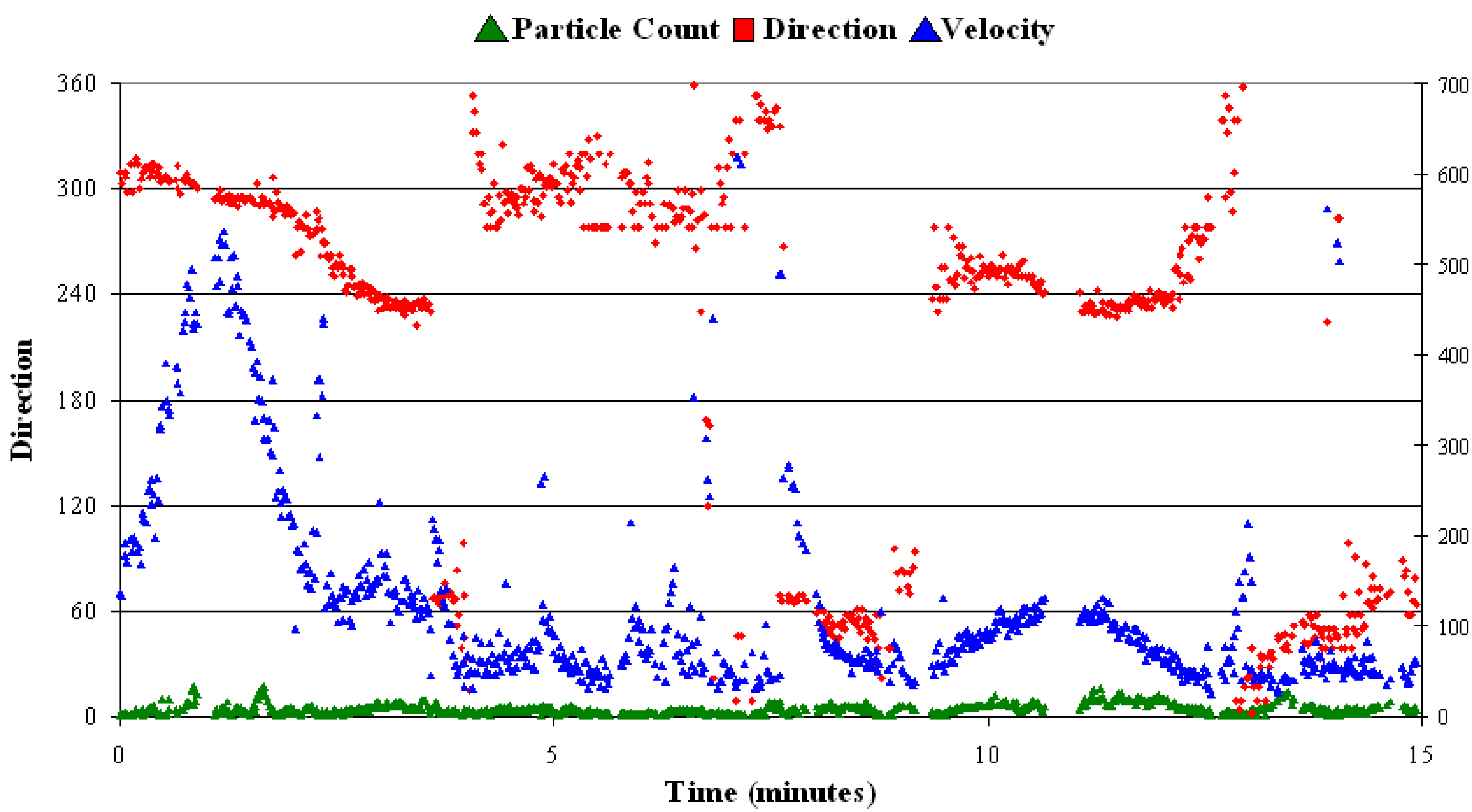
Swirling Non-Directional Flow Zone
464 Ft BGS



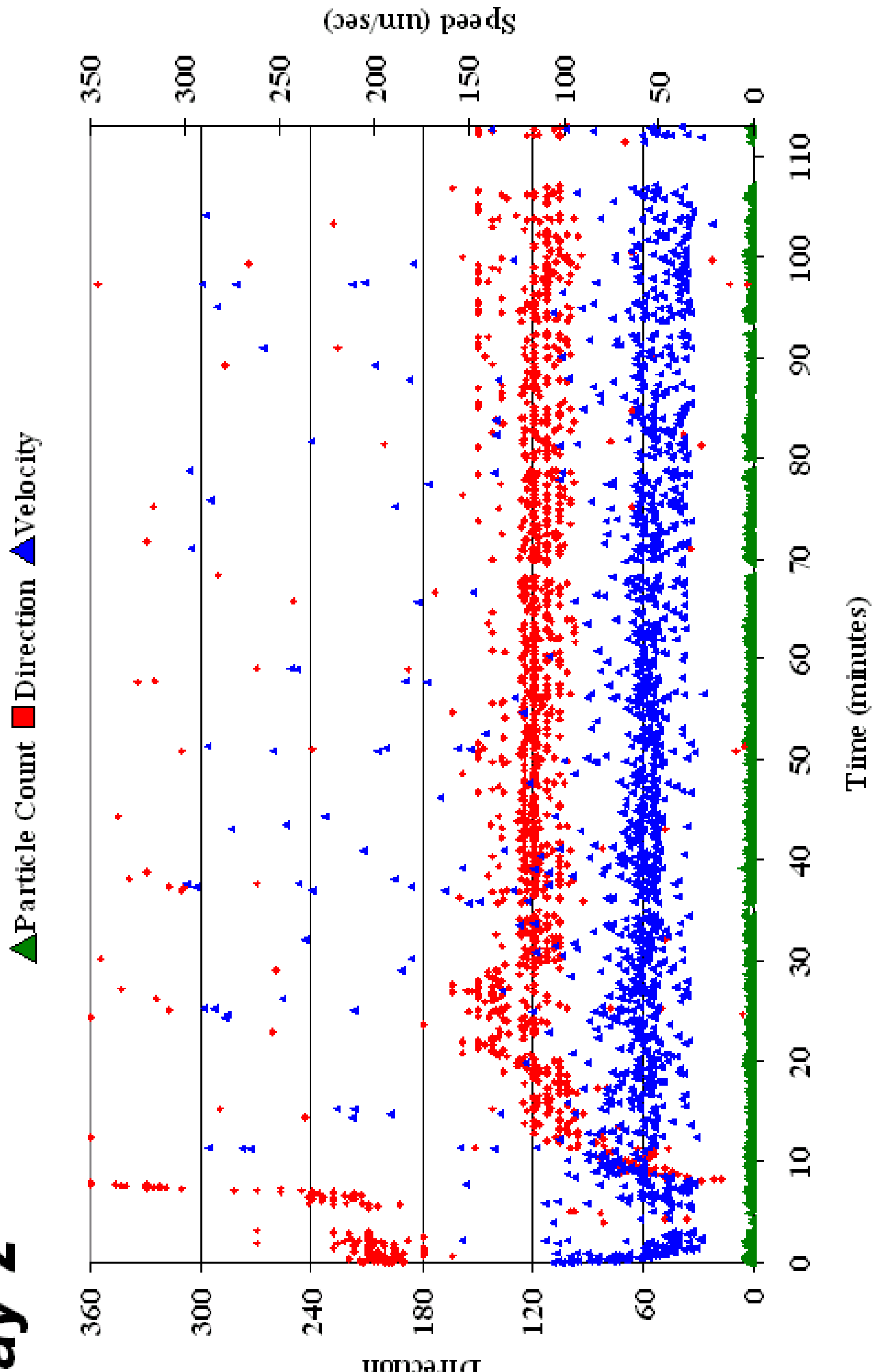
Swirling Non-Directional Flow Zone 465 Ft BGS



Swirling Non-Directional Flow Zone 483 Ft BGS

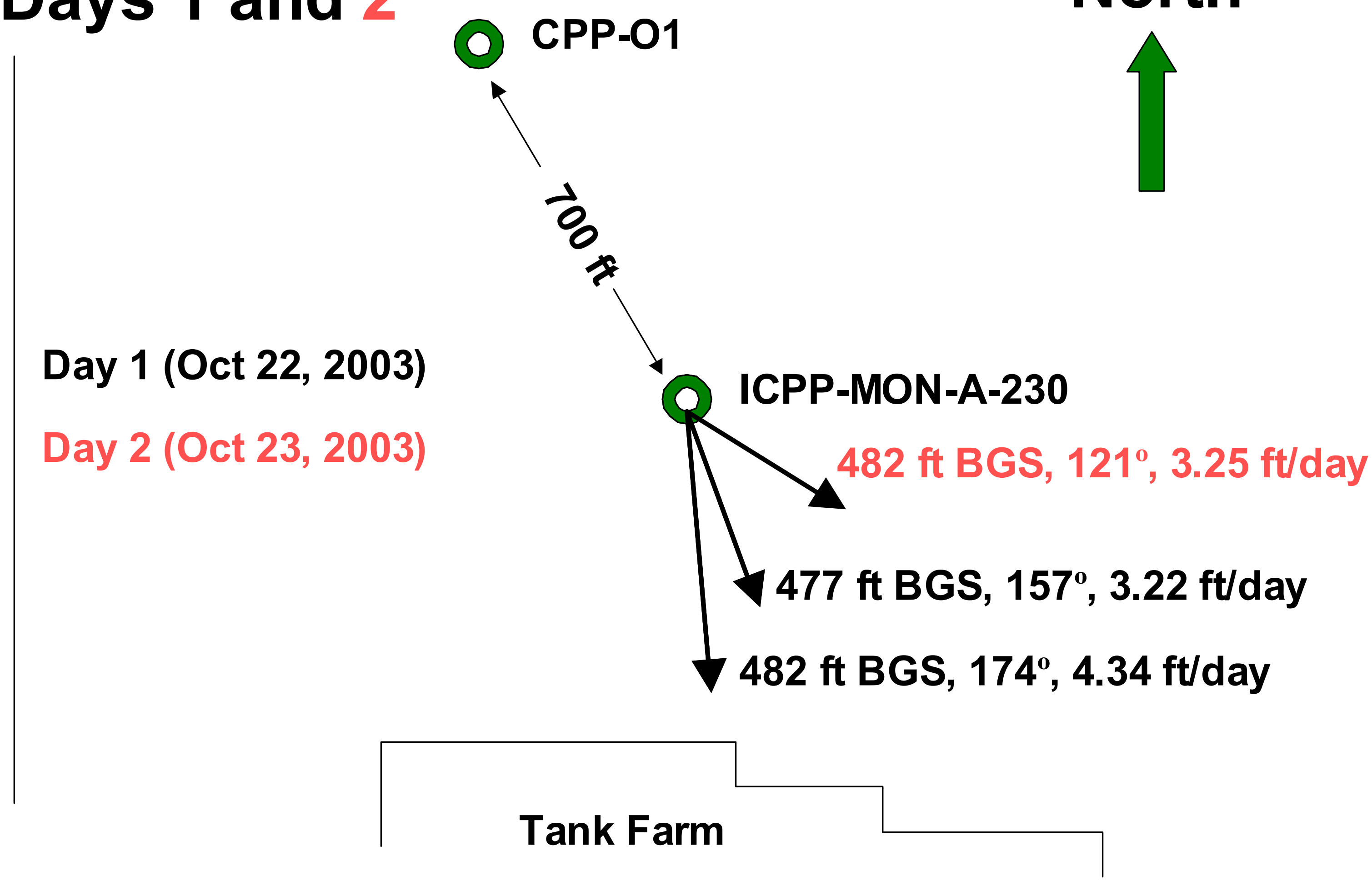


Reliable Flow at 482 Feet BGS Day 2



Average Direction: 121 - Average Velocity: 46 um/sec - Average Seepage Velocity: 3.25 ft/day

Plot of Reliable Flow Days 1 and 2



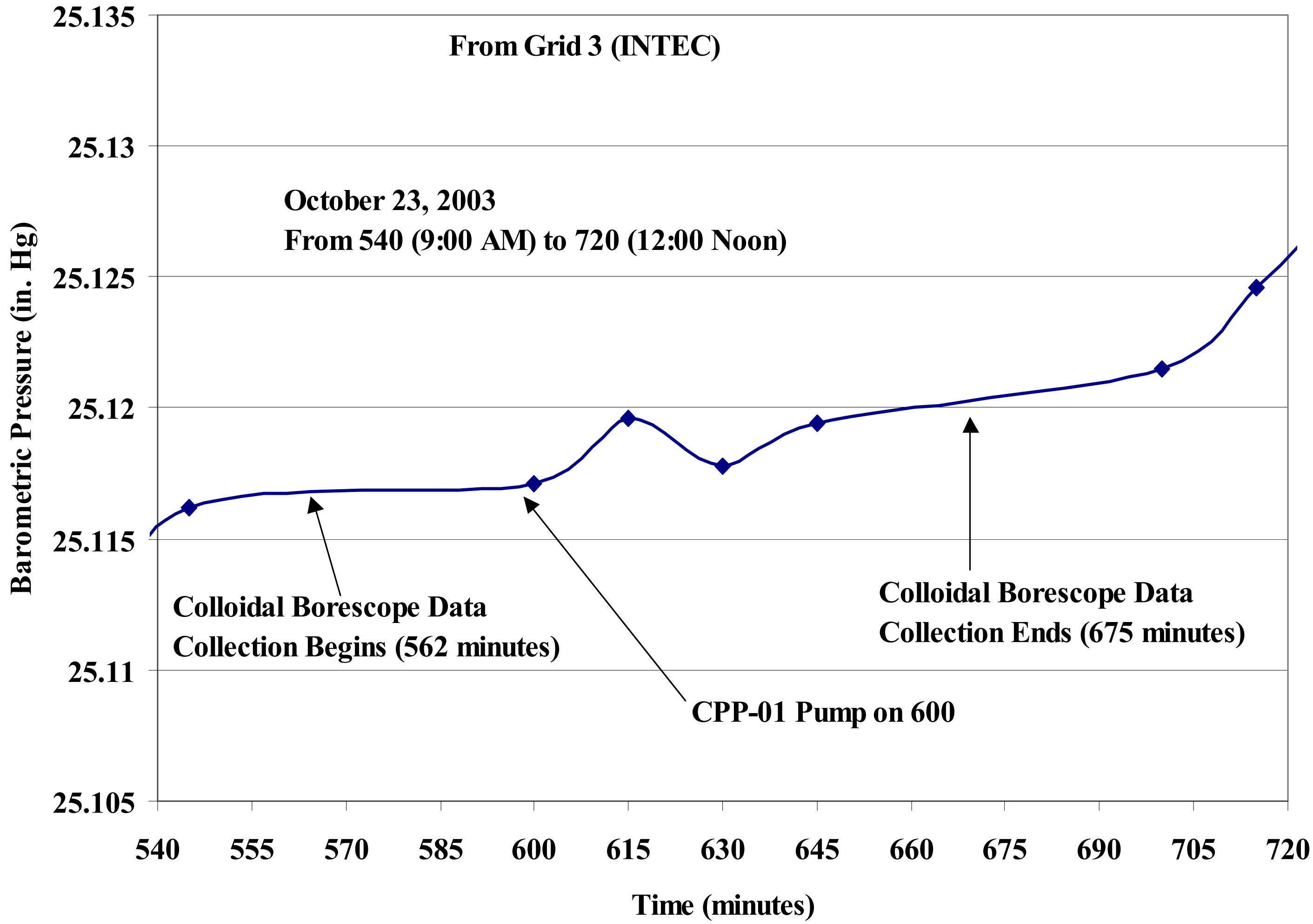
Did CPP-01 Influence Flow Direction?

- *Data collection at ICPP-MON-A-230 began at 9:22 AM on day 2*
- *Production pump at CPP-01 turned on at 10:00 AM, 2,906 gpm*

Minutes Before CPP-01 Turned On		
Time Interval	Direction (degrees)	Velocity (μm/sec)
0 to 10	128	67
10 to 20	not rep. flow	
20 to 30	not rep. flow	
30 to 40	not rep. flow	

Minutes After CPP-01 Turned On		
Time Interval	Direction (degrees)	Velocity (μm/sec)
0 to 10	123	62
10 to 20	124	63
20 to 30	122	56
30 to 40	119	55
40 to 50	120	53
50 to 60	118	56
60 to 70	111	47
70 to 80	111	52

Barometric Pressure



References

- *Kearl, P.M., Korte, N.E., Stites, M,. And Baker, J. 1994. Field comparisons of micro purge vs. Traditional groundwater sampling. Groundwater Monitoring and Remediation, Fall, 183-190.*
- *Shanklin, D.E., 1996. Colloidal Borescope Groundwater Flow Measurements Along the Southern Boundary of the Fernald Environmental Management Project. USDOE, Cincinnati, Ohio, Under Contract DE-AC05-86R21600.*
- *Kearl, P.M. 1997. Observations of particle movement in a monitoring well using the colloidal borescope. Journal of Hydrology, 200, 323-344.*
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- *Kearl, P.M., And Roemer, E.K. 1999. Characterization of a fractured aquifer using the colloidal borescope. Advances in Environmental Research, 3 (1).*
- *Korte, N., R. L. Siegrist, P. M. Kearl, M. T. Muck, and R. M. Schlosser. An evaluation of aquifer heterogeneity using multiple methods: Single well tests, pumping tests, tracer tests and the colloidal borescope. Ground Water Monitoring and Remediation (in press).*

Appendix F

INTEC Well Field Capture Zone Analysis

Evaluation of Well Capture Zones at the Idaho Nuclear Technology Engineering Center

F-1 INTRODUCTION AND BACKGROUND

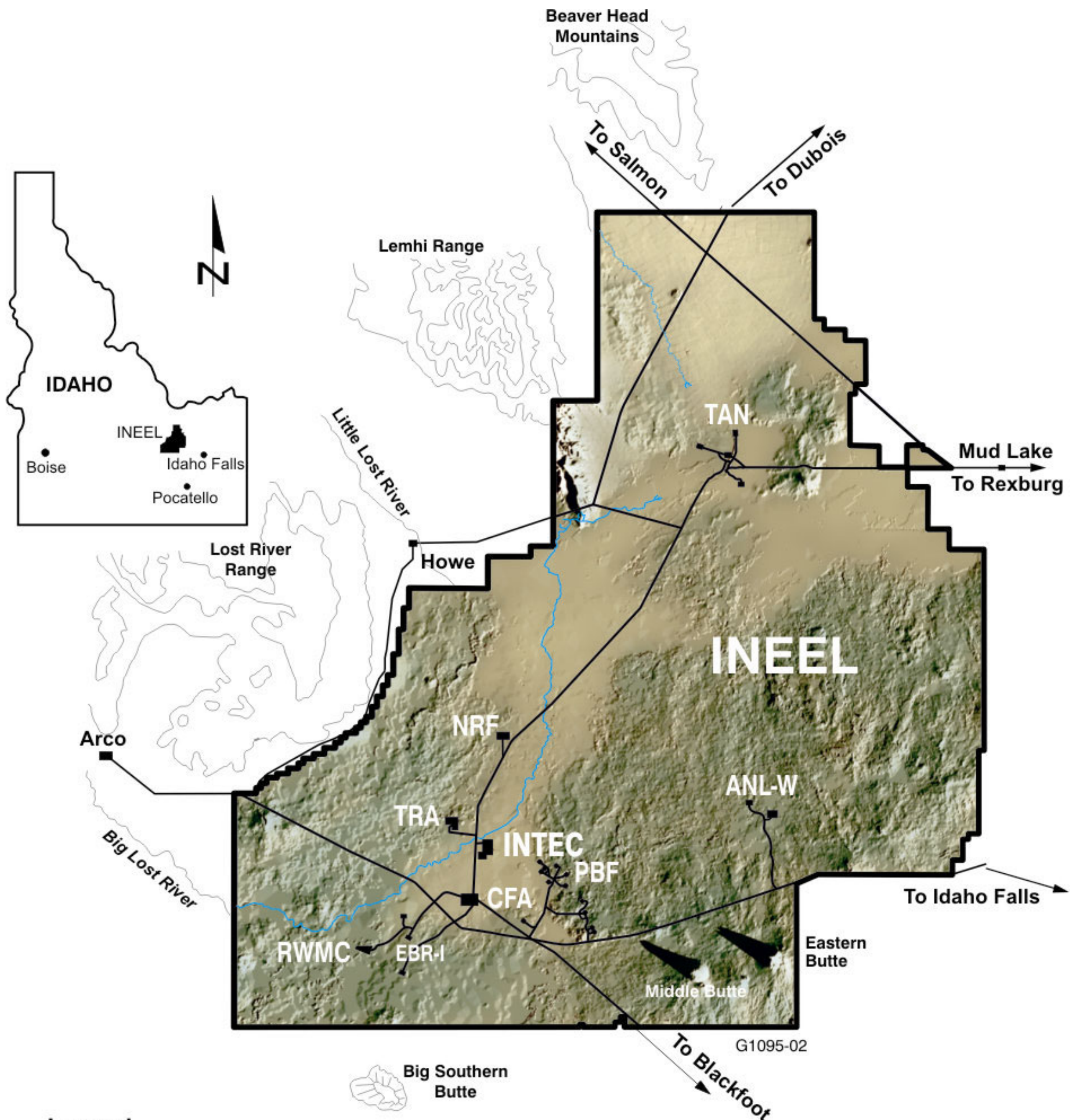
Idaho Nuclear Technology and Engineering Center (INTEC) is a large industrial complex located in the south-central portion of the INEEL. Historically, the mission of INTEC has been to recover fissile uranium by reprocessing spent nuclear fuel. The resulting liquid waste generated from this process was an acidic high-level liquid waste which contained fission products, transuranic elements, and various metals. The liquid waste was temporarily stored in an underground Tank Farm Facility located at the INTEC until the liquid radioactive waste was converted to a solid granular form by a process designated as calcination. During the calcination process, the liquid in the radioactive waste is evaporated and the dissolved metals and fission products are converted to salts and oxides (Palmer et al. 1998). The location of the INEEL, INTEC, and the tank farm is illustrated in Figure F-1.

The Tank Farm Facility includes 11 belowground 300,000-gal tanks in concrete vaults, and four belowground 30,000-gal tanks. Two types of liquid waste have been stored at the Tank Farm Facility. The first is high-level nonsodium-bearing waste, which was generated from first-cycle reprocessing spent nuclear fuel. The second is sodium-bearing waste generated from second- and third-cycle reprocessing and other INTEC operations such as decontamination activities (DOE-ID 1997). The liquid wastes from various INTEC facilities were transferred to the tank farm through a system of interconnected underground pipes. The storage tanks have never leaked, but leaks and spills have occurred during waste transfer activities, thereby releasing contaminants to the alluvial fill material surrounding the tank farm, which may eventually reach the Snake River Plain Aquifer below. The contamination at the INTEC is a site on the National Priorities List and is currently undergoing investigation for remedial actions.

Recent monitoring in a new aquifer well (designated TF-Aquifer or ICPP-MON-A-230), located near the Tank Farm Facility has detected Tc-99 at concentrations exceeding the MCL. The monitoring well is located within the INTEC security fence line and approximately 300 ft north of the tank farm fence line. The detected concentration was 2,220 pCi/L from a water sample collected on May 13, 2003. The Tc-99 drinking water MCL is 900 pCi/L. The previous maximum concentration was 518 pCi/L detected at Well MW-18, located 300 ft south-east of the tank farm in December 1994.

The INTEC has two water production systems designated for industrial process and potable water use and each system has two wells. The process water system produces an average 5,570 m^3/day (1.5 million gpd) from the CPP-1 and CPP-2 wells located near the northern INTEC fence line. The CPP-1 and CPP-2 wells produce 15,525 m^3/day (2,850 gpm) when operating and cycle two times per day for approximately 1.3 hours each cycle. Production is alternated between the CPP-1 and CPP-2 wells every 2 weeks.

The potable water system produces an average of 136 m^3/day (36,000 gpd) from the CPP-4 and CPP-5 wells located approximately 240 m north of the northern INTEC fence line. The CPP-4 well produces 2,453 m^3/day (450 gpm) when operating and cycles three times per day for approximately 0.45 hours each cycle. The CPP-5 well produces 818 m^3/day (150 gpm) when operating and cycles three times per day for approximately 1.3 hours each cycle. Production is alternated between the CPP-4 and CPP-5 wells every 24 hours.



Legend

ANL-W	=	Argonne National Laboratory-West
CFA	=	Central Facilities Area
EBR-I	=	Experimental Breeder Reactor I
INEEL	=	Idaho National Engineering and Environmental Laboratory
INTEC	=	Idaho Nuclear Technology and Engineering Center
NRF	=	Naval Reactors Facility
PBF	=	Power Burst Facility
RWMC	=	Radioactive Waste Management Complex
TAN	=	Test Area North
TRA	=	Test Reactor Area

Figure F-1. Map showing the location of the INEEL and INTEC (from Figure 1 of DOE-ID [2002])

F-1.1 INTEC Hydrogeology

The hydrogeologic setting of the INTEC is very complex, consisting of alternating layers of basalt and sediments. In the vadose zone, numerous perched water bodies have formed beneath surface recharge sources. The geology of the aquifer is more uniform in the vertical direction than that of the vadose zone. The older and deeper basalt flows in the aquifer tend to be thicker than the vadose zone basalt flows, and the sedimentary interbeds are fewer in number. The lowermost basalt flow in the aquifer is thought to have a lower permeability and be significantly thicker than the overlying basalt flows.

The Snake River Plain Aquifer is located approximately 137 m below land surface. The aquifer can behave as either a semi-confined or confined system. Local confining conditions exist below some interbeds and low permeability basalt layers. The Big Lost River flows adjacent to the northern INTEC facility boundary and is an intermittent stream.

Several isolated perched water zones have developed under the tank farm as result of INTEC operations and natural recharge from precipitation and the Big Lost River. Possible INTEC anthropogenic perched water and aquifer recharge sources include a sewage treatment lagoon, below-grade subsurface steam disposal vents, water supply line leaks, and landscape irrigation. In August 2002, the percolation ponds were moved to a new location 2 miles west. A cartoon of the INTEC subsurface is illustrated in Figure F-2.

F-2 OBJECTIVES

Capture zone analysis of the INTEC production wells (CPP-1, -2, -3, and -4) was performed to determine if these wells capture water beneath the tank farm. The analysis used the MODFLOW (MacDonald and Harbaugh 1988) and MODPATH (Pollock 1994) computer software. MODFLOW is a three-dimensional groundwater flow simulator produced by the United States Geological Survey and MODPATH is particle tracking companion software for MODFLOW. The MODFLOW and MODPATH software was used to simulate steady-state and transient flow paths to the INTEC production wells.

F-3. MODEL ASSUMPTIONS AND IMPLEMENTATION

F-3.1 Simulation Domain

The simulation domain was 3-dimensional, extended 2,400 × 2,400 m in the horizontal direction, 240 m in the vertical direction, and was centered on the CPP-1 Production Well. The numerical grid used 40- × 40-m grid blocks in the horizontal and 12-m grid blocks in the vertical directions. Figure F-3 illustrates a plan view of the model domain and location relative to the INTEC facility and the Test Reactor Area, which is located north-west of the INTEC.

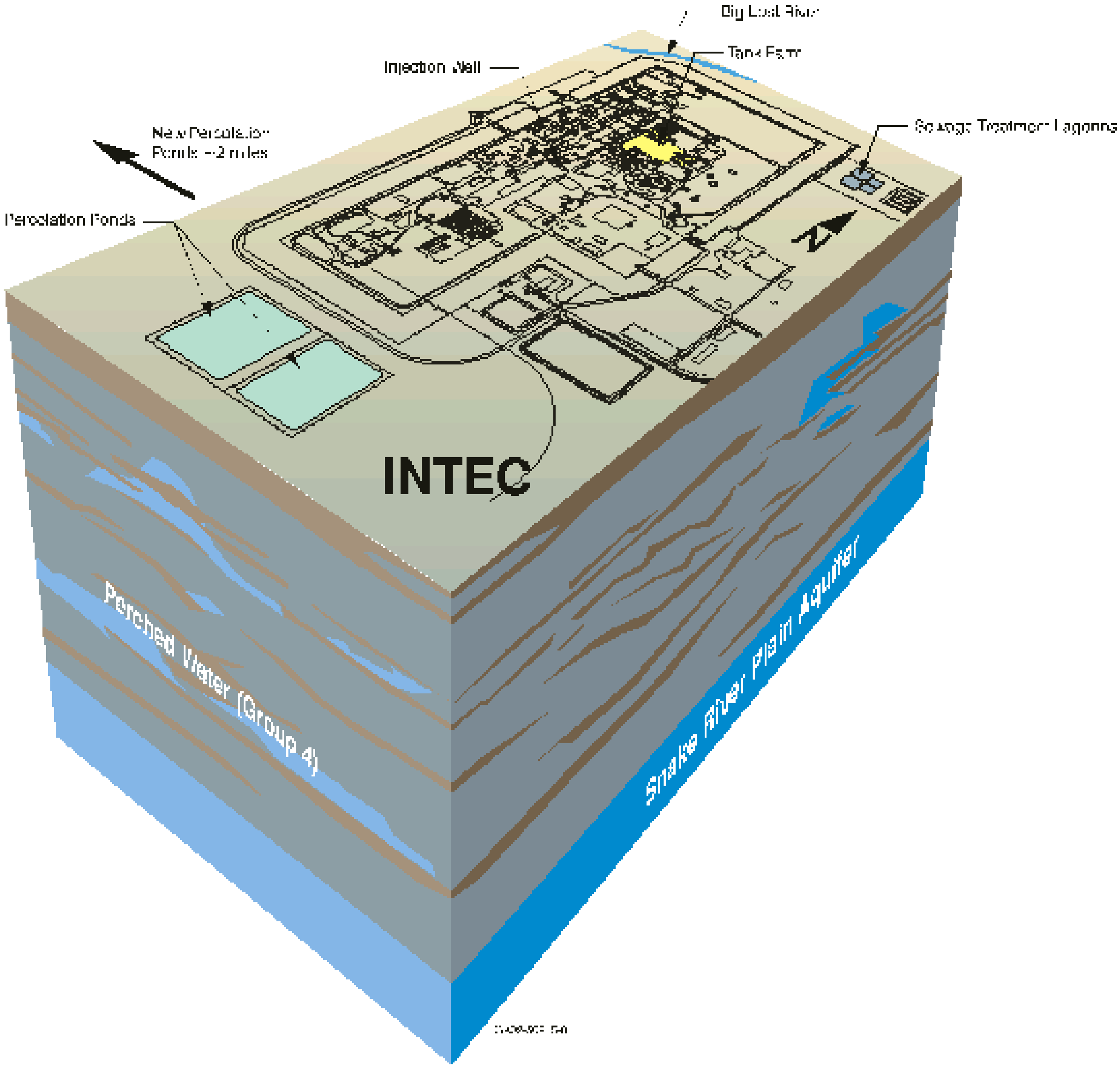


Figure F-2. Cartoon illustrating the INTEC facility footprint and subsurface (from Figure 2-2 of DOE-ID [2003])

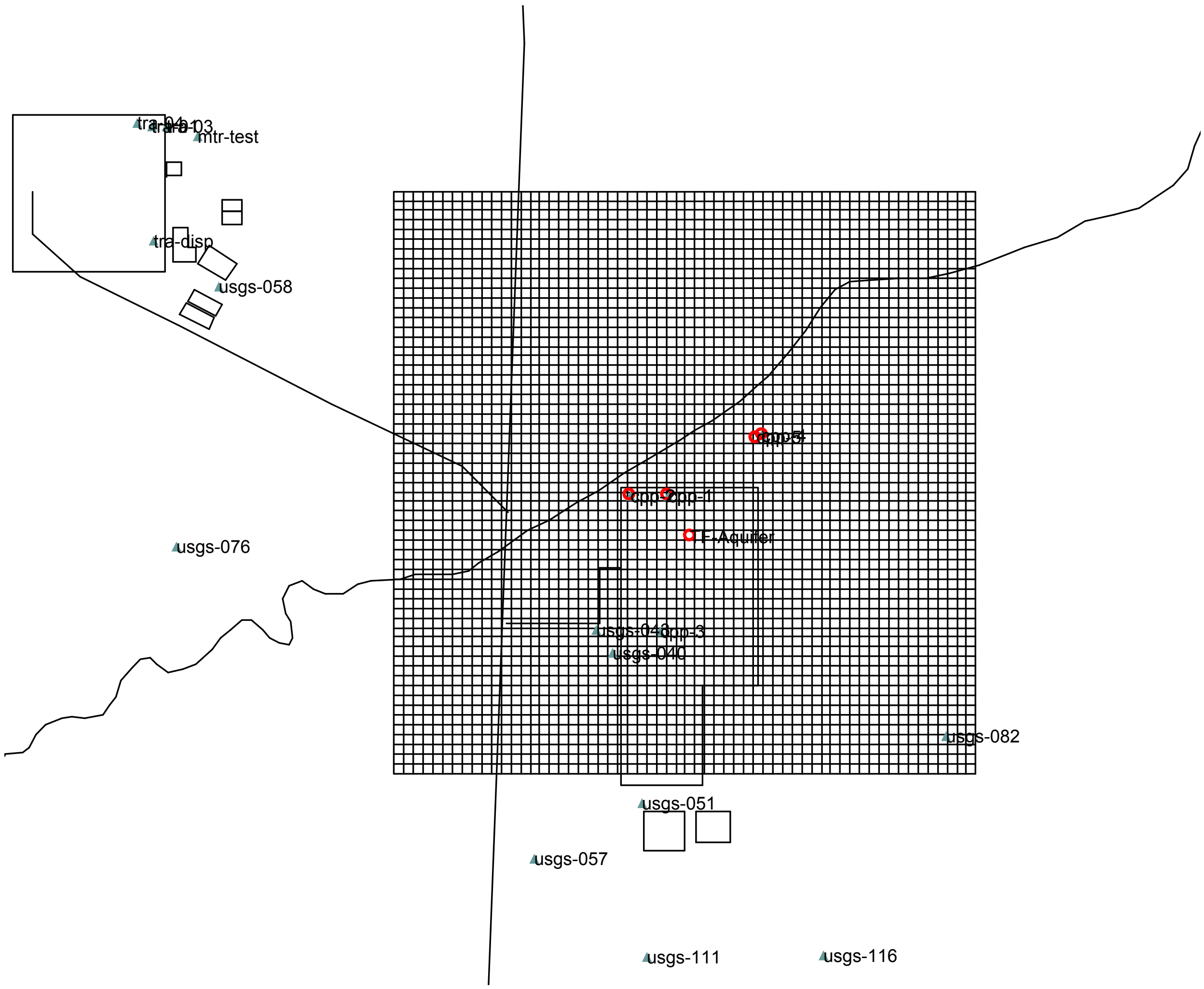


Figure F-3. INTEC production well capture zone model domain.

F-3.2 Boundary Conditions

The capture zone model was parameterized from the Group 5 aquifer model (DOE-ID 2004). The capture zone model lateral boundary conditions were specified head and were estimated from the Group 5 aquifer model's simulated aquifer gradient. These boundary conditions provided a hydraulic gradient of approximately 1/2000 in the capture zone model area.

The Group 5 aquifer model was used to estimate the gradient in the capture zone area because direct measurements of the aquifer potentiometric surface from observation wells do not provide a reliable estimate of aquifer gradient and direction on a local scale. Direct measurement of the aquifer potentiometric surface is unreliable because of measurement error due to barometric effects, well bore deviation, and measurement device accuracy and/or precision. Barometric effects limit well accuracy to approximately ±0.5 m at the INEEL. Well bore deviation can limit accuracy to approximately ±1 m and the accuracy of steel measuring tapes may be limited to approximately ±0.1 m due to tape stretch and temperature effects. Most INEEL wells have been surveyed and corrected for well bore deviations, thus, most measurements are limited to ±0.5 m. This error is approximately 1/2 the aquifer gradient, which is 1.2 m, across the simulated aquifer domain. The Group 5 regional aquifer model adequately matched the large-scale aquifer gradient from north of the INTEC to the southern INEEL boundary.

The capture zone model surface boundary conditions were specified flux, which included surface recharge from the Big Lost River, precipitation and INTEC facility water sources. The surface recharge rates were estimated from the OU 3-13 RI/BRA (DOE-ID 1997). The flow path analysis considered transient effects of the process water wells, but only considered steady-state effects of the potable water wells. The well production rates were estimated from current INTEC well operation logs. The surface recharge rates are presented in Table F-1 and the production well rates are presented in Table F-2.

Table F-1. Capture zone model surface recharge.

Recharge Source	Total Water Release Rate (kg/day)	Recharge Area (m^2)	Flux (m/day)
Big Lost River	897,871	96,000	0.0094
Precipitation outside fenced area (1 cm/yr)	141,667	5,174,400	0.000027
Precipitation inside fenced area (10 cm/yr)	160,328	585,600	0.00027
Water system leaks	41,300	313,200	0.00013
Landscape irrigation	16,300	313,200	0.00005
Sewage treatment lagoon	155,600	313,200	0.00050
Steam vent discharge	13,500	313,200	0.00004
Total Recharge Inside Fence Line			0.00100

Table F-2. INTEC production well rates and screen locations.

Well	Transient Rate (m^3/day)	Transient Period (days)	Pumping Frequency (1/day)	Average Rate for the Period April-July, 2003 (m^3/day)	Screened Interval Depth Below Simulated Water Table (m)	Simulation Vertical Grid Block (from surface @ 12 m each)
CPP-1	16353	0.170	2	2785	2.9-10.9 and 23.5-38.6	1 and 3
CPP-2	Pumping alternates between CPP-1 and CPP-2 every 2 weeks			2785	1.8-9.5 and 30.1 and 45.1	1 and 4
CPP-4	2453	0.019	3	68.29	1.9-45.2	1,2,3, and 4
CPP-5	818	0.056	3	68.29	85.6 open hole	1,2,3,4,5,6, and 7

F-3.3 Hydrologic Parameters

The Group 5 aquifer model (DOE-ID 2004) used three lithologic units, which included an upper basalt layer located above a sedimentary interbed, the interbed (designated as the HI interbed), and a lower basalt layer located below the interbed. The Group 5 model's parameterization of these three lithologic units was performed using aquifer well test data, laboratory analysis of core, and regional scale modeling. Spatial analysis of well test data was used to parameterize the upper basalt, well test data and core analysis were used to parameterize the HI interbed, and hydraulic conductivity taken from the WAG 10 regional model (McCarthy et al. 1995) was used to parameterize the lower basalt. The HI interbed tends to dip in the southeast direction and rises above the water table in the vicinity of the INTEC tank farm. The Group 5 model's upper basalt layer included the top 25 m of aquifer located below the HI interbed, and within 25 m of the water table in the region where the HI interbed nears the water table. This was done because well test data were available to parameterize the basalt located beneath the HI interbed in this region.

The capture zone modeling used a simplified lithology based on the Group 5 aquifer model, which only included the upper and lower basalt layers. The upper basalt layer was 24 m thick and was parameterized from interpolation of the Group 5 model's well test data onto the finer grid. The lower basalt layer was 216 m thick and was parameterized from the Group 5 model's lower basalt layer. The HI interbed was excluded from the capture zone model because a large fraction of the capture zone model area is located where the HI interbed rises above the water table.

The Group 5 aquifer model was calibrated to very early (1950s) tritium disposal in an aquifer injection/disposal well and the resulting tritium plume. Matching the historical tritium plume originating from the INTEC disposal well operations required reducing the interpolated hydraulic conductivity field by a factor of 2. Reducing the interpolated hydraulic conductivity field most likely corrected the bias in the hydraulic conductivity estimated from well tests. Water production wells are usually completed in the most productive depth encountered during drilling, which may not represent the large-scale hydraulic conductivity of the aquifer. This correction was also applied to the capture zone model's upper basalt layer. Table F-3 presents the capture zone model hydrologic parameters and Figure F-4 illustrates the upper basalt layer hydraulic conductivity field.

The capture model used the MODFLOW convertible layer option, which converts a grid block from confined to unconfined as the water level in the grid block falls below the top of the grid block.

Table F-3. Capture zone model hydrologic parameters.

Parameter	Value
Upper basalt (model surface to 25 m)	Hydraulic conductivity field (see Figure F-4)
Lower basalt (25 m to model bottom)	70.1 (m/day)
Porosity	0.03 (dimensionless)
Horizontal to vertical anisotropy	10 to 1 (dimensionless)
Specific storage	0.0005 (dimensionless)
Specific yield	0.03 (dimensionless)

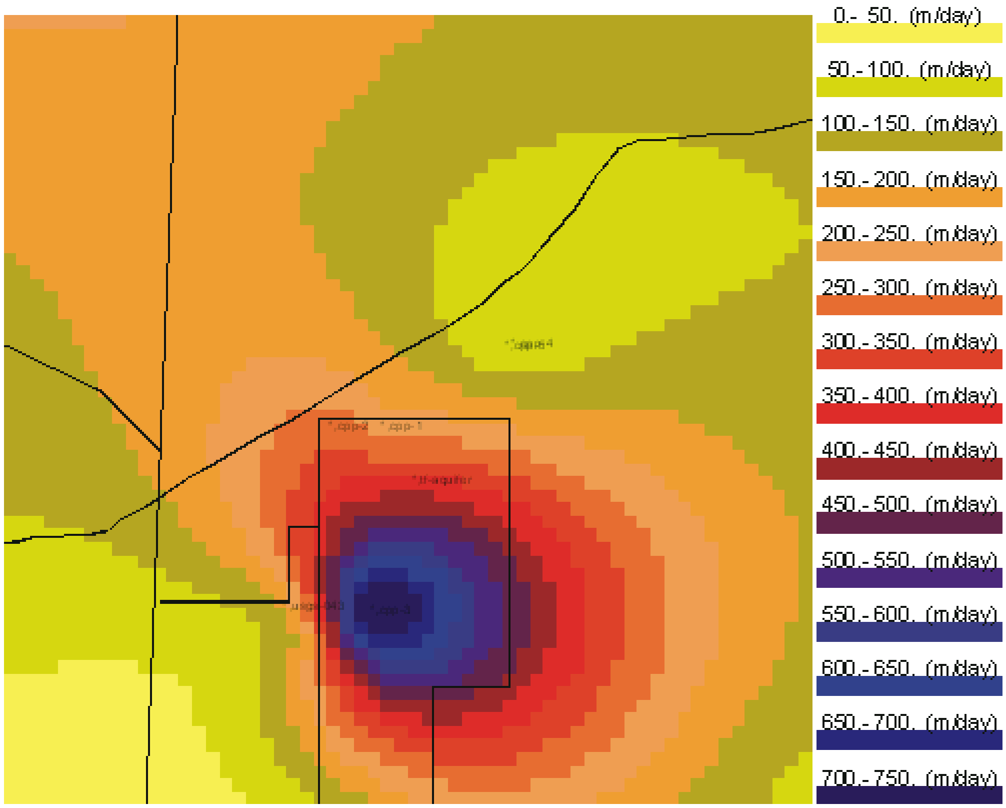


Figure F-4. Upper basalt hydraulic conductivity field.

F-4. SIMULATION RESULTS

F-4.1 Steady-State Results

The most conservative surface recharge scenario for estimating the production well capture zones would include INTEC facility recharge without the Big Lost River. The Big Lost River is located north of the production wells, and the resulting groundwater mound would increase the overall north-south gradient, thus decreasing the southern extent of the production well capture zones.

The steady-state simulations were used to evaluate capture zone sensitivity to surface recharge from INTEC operations and the Big Lost River. The simulations included three scenarios assuming the following recharge conditions:

- Steady-state pumping with surface water recharge originating from the northern INTEC, which included precipitation, water system leaks, landscape irrigation, steam condensate, sewage treatment ponds, and the Big Lost River. All the recharge rates were estimated from Table 1-8 of the OU 3-13 RI/BRA, Appendix F (DOE-ID 1997). The northern INTEC recharge was distributed uniformly over the area within the northern INTEC fence line and the Big Lost River recharge was distributed over grid blocks under the river's path. The Big Lost River recharge was estimated from the average losses between the INEEL diversion dam and Lincoln Boulevard for the period 1967–1987.

- INTEC surface recharge noted in Bullet 1 without the long-term average Big Lost River recharge.

- Steady-state pumping without surface recharge.

F-4.1.1 Steady-State Pumping, INTEC Facility Surface Recharge, and Big Lost River Surface Recharge

The steady-state pumping simulation with INTEC and Big Lost River recharge indicates the process well capture zone will extend approximately midway between the CPP-1 production well and the tank farm aquifer well. The lateral extent of the capture zone is approximately 360 m east or west of each well at the model's northern boundary. The vertical extent of the capture zone is approximately 120 m below the water table. The steady-state capture zone extends within approximately 80 m of the tank farm aquifer well. Drawdown at the CPP-1 production well is approximately 0.22 m over a 40- × 40-m area (1 model grid block). Figure F-5 illustrates the flow pathlines and aquifer potentiometric surface in plan view. Figure F-6 illustrates the flow pathlines in side view looking west, and Figure F-7 illustrates the flow pathlines in side view looking north.

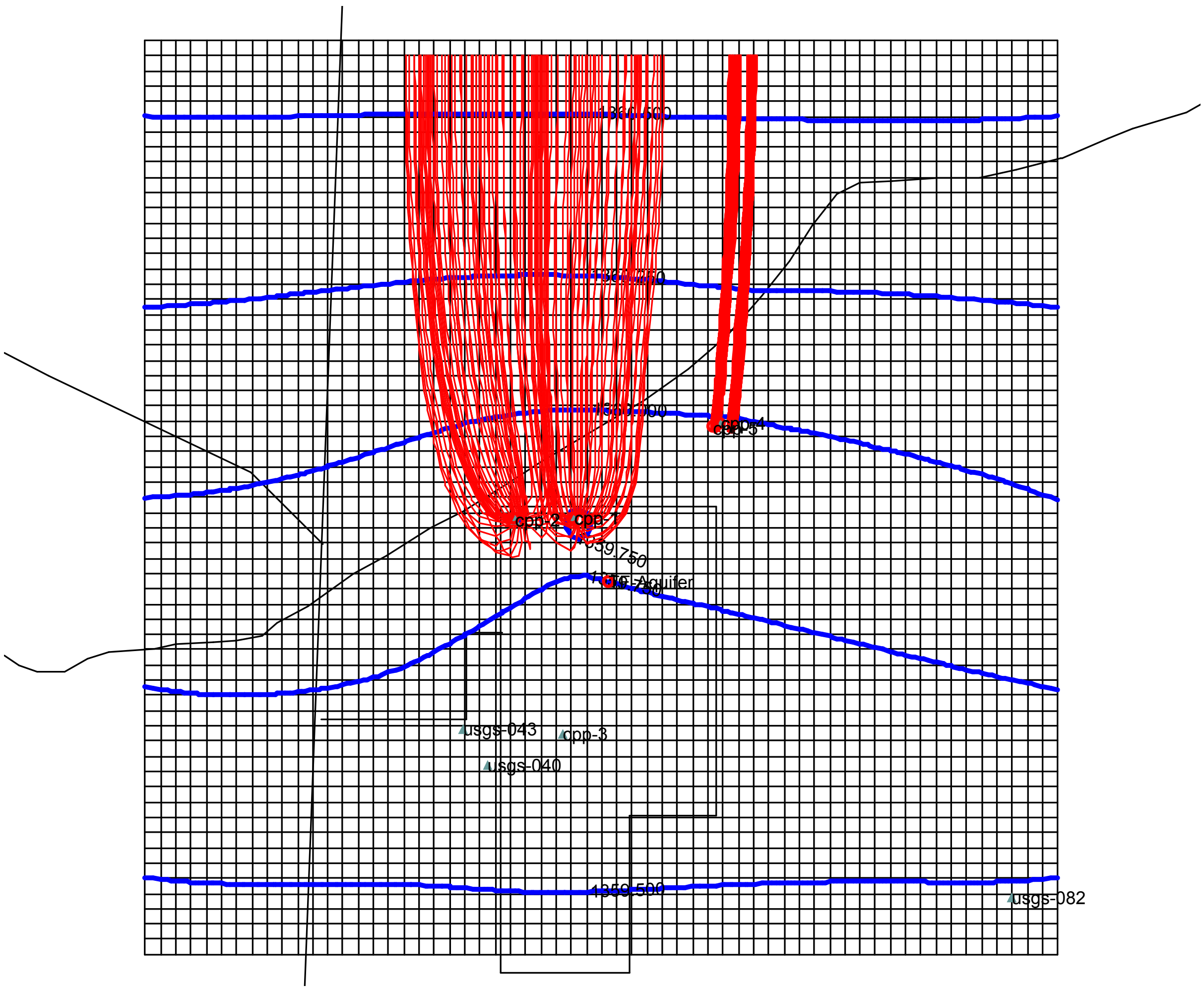


Figure F-5. Steady-state pumping with INTEC and Big Lost River recharge flow pathline plan view.

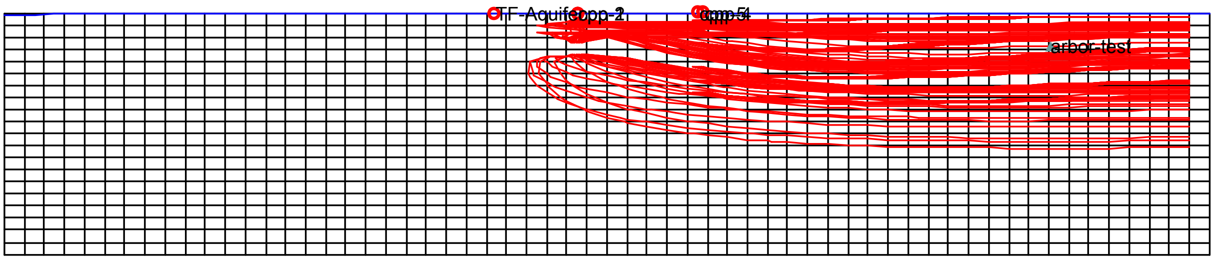


Figure F-6. Steady-state pumping with INTEC and Big Lost River recharge flow pathline side view looking west with 2x vertical exaggeration.

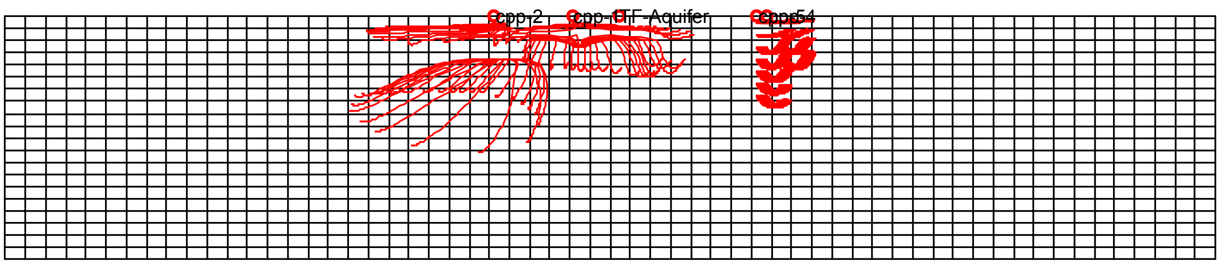


Figure F-7. Steady-state pumping with INTEC facility and Big Lost River recharge flow pathline side view looking north with 2x vertical exaggeration.

F-4.1.2 Steady-State Pumping and Surface Recharge Sensitivity

Removing the Big Lost River and/or INTEC facility surface recharge did not have a dramatic affect on aquifer potentiometric surface. The volume of recharge water is small and distributed over a large area compared to the volume of water extracted from the process water production wells. The daily total volume of water related to INTEC operations was approximately 227 m^3. The daily total volume of water related to the Big Lost River was 898 m^3/day. The average combined production rate of the CPP-1 and CPP-2 production wells was 2,785 m^3/day.

The steady-state simulations with and without surface recharge indicated well capture zones are not significantly changed by the Big Lost River or INTEC facility recharge sources. However, the INTEC facility recharge did not include the relocated percolations ponds (the final recipient of the process water), which were relocated from the southern end of the INTEC facility to a new location approximately 2 miles west of the INTEC facility. Figure F-8 illustrates the flow pathlines and aquifer potentiometric surface in plan view without Big Lost River recharge, and Figure F-9 illustrates the flow pathlines and aquifer potentiometric surface in plan view with precipitation recharge only.

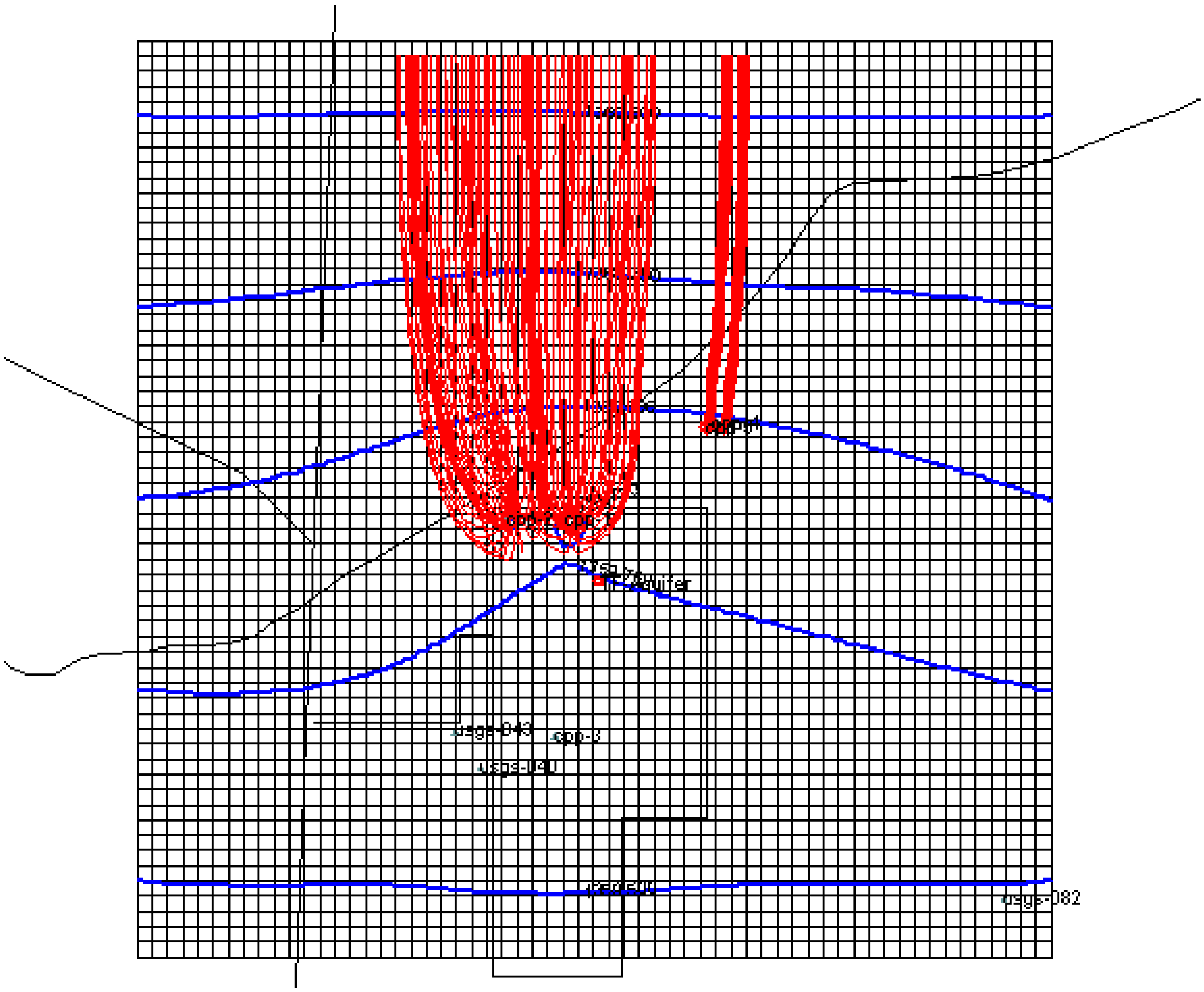


Figure F-8. Flow pathline plan view with steady-state pumping without Big Lost River (INTEC facility recharge and precipitation recharge only).

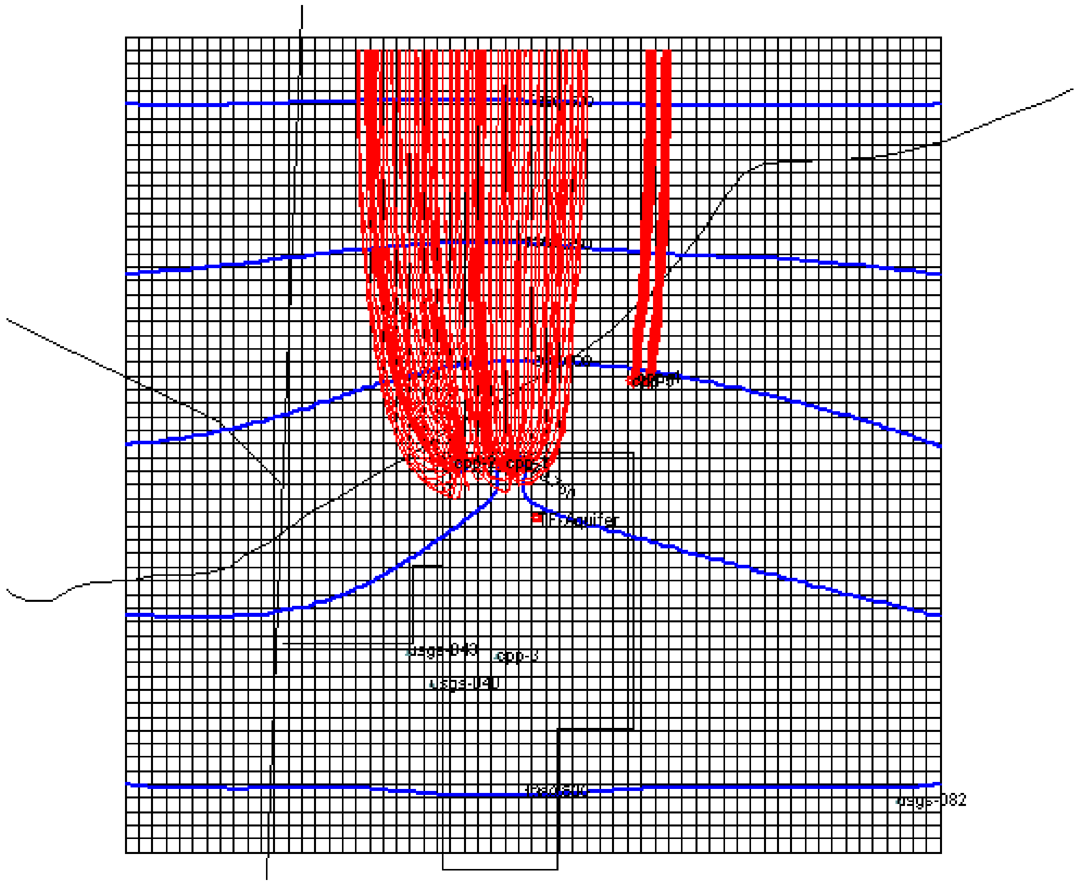


Figure F-9. Flow pathline plan view with steady-state pumping without Big Lost River or facility recharge (precipitation recharge only).

F-4.2 Transient Results

The transient simulations provide the most realistic evaluation of the INTEC production well capture zones but were only performed for a relatively short period of time compared to INTEC operational history because of computational restraints. The twice-daily cycle and large production volume of the process water wells require a large number of simulation time steps even for a short simulation period. The transient analysis was performed to determine sensitivity to the bi-daily cycling and bimonthly switching between the CPP-1 and CPP-2 wells. Two transient simulations were performed to evaluate the transient pumping effects. The first considered a 2-week simulation of transient well CPP-1 operation, which was compared to a 2-week steady-state CPP-1 well operation simulation. The second simulation considered a 14-month simulation with bimonthly switching between the CPP-1 and CPP-2 wells, which was compared to a 14-month steady-state simulation of the CPP-1 and CPP-2 wells.

F-4.2.1 Transient Simulation of Cycling Well CPP-1

The twice-daily cycling of the CPP-1 well did not have a significant impact on the simulated well capture zone. This is because the short pumping cycle and recovery period did not allow the aquifer to completely recover between cycles. The only difference between the steady-state and transient simulation flow paths was a slight zigzag pattern within the transient flow paths. Figure F-10 illustrates the flow pathlines plan view after 14 days of transient cycling in Well CPP-1, and Figure F-11 illustrates the flow pathlines plan view after 14 days of steady-state pumping in Well CPP-1.

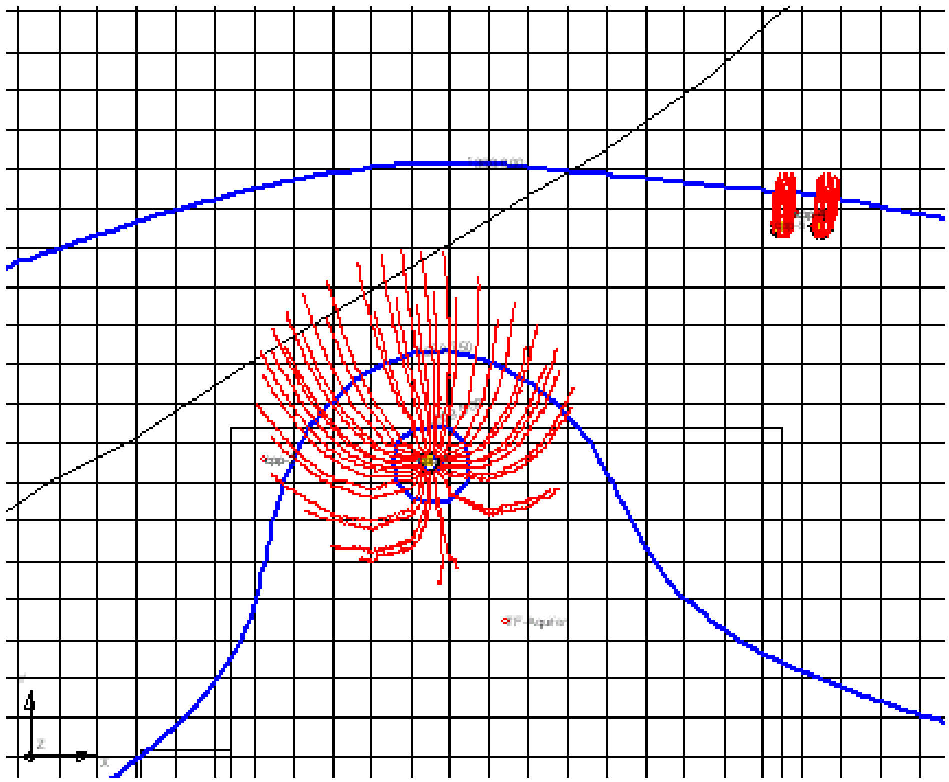


Figure F-10. Flow pathlines plan view for 14 days of Well CPP-1 transient cycling.

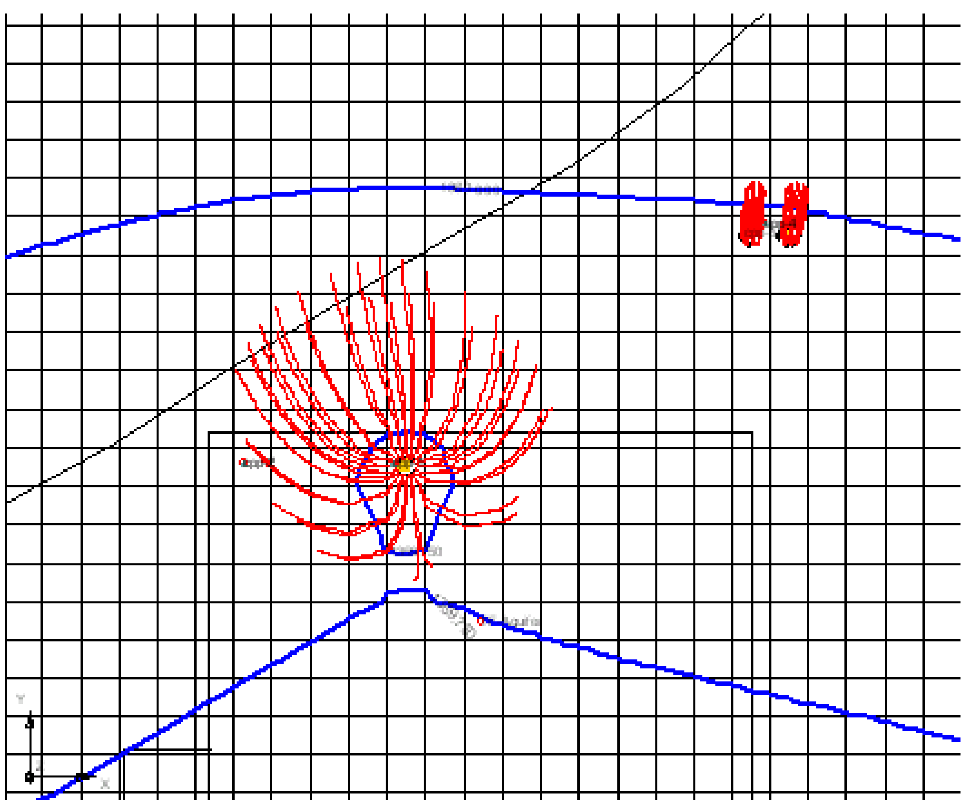


Figure F-11. Flow pathline plan view for 14 days of steady-state Well CPP-1 production.

F-4.2.2 Transient Simulation of Cycling Between Wells CPP-1 and CPP-2

The transient well switching simulation indicates the CPP-1 well capture zone extends to within approximately 40 m of the tank farm aquifer well. The bimonthly switching between CPP-1 and CPP-2 as the process water producer has a large impact on capture zone because the 2-week operation period and the 2-week inactive period allows the aquifer drawdown to reach steady state during pumping and fully recover during the shutdown period. Drawdown at the CPP-1 production well is approximately 0.37 m over a 40- × 40-m area (1 model grid block) at the end of the 14-day operation period. Figure F-12 illustrates the flow pathlines plan view after 784 days of bimonthly switching between wells CPP-1 and CPP-2. Figure F-13 illustrates the flow pathlines plan view after 784 days of steady-state pumping in Wells CPP-1 and CPP-2.

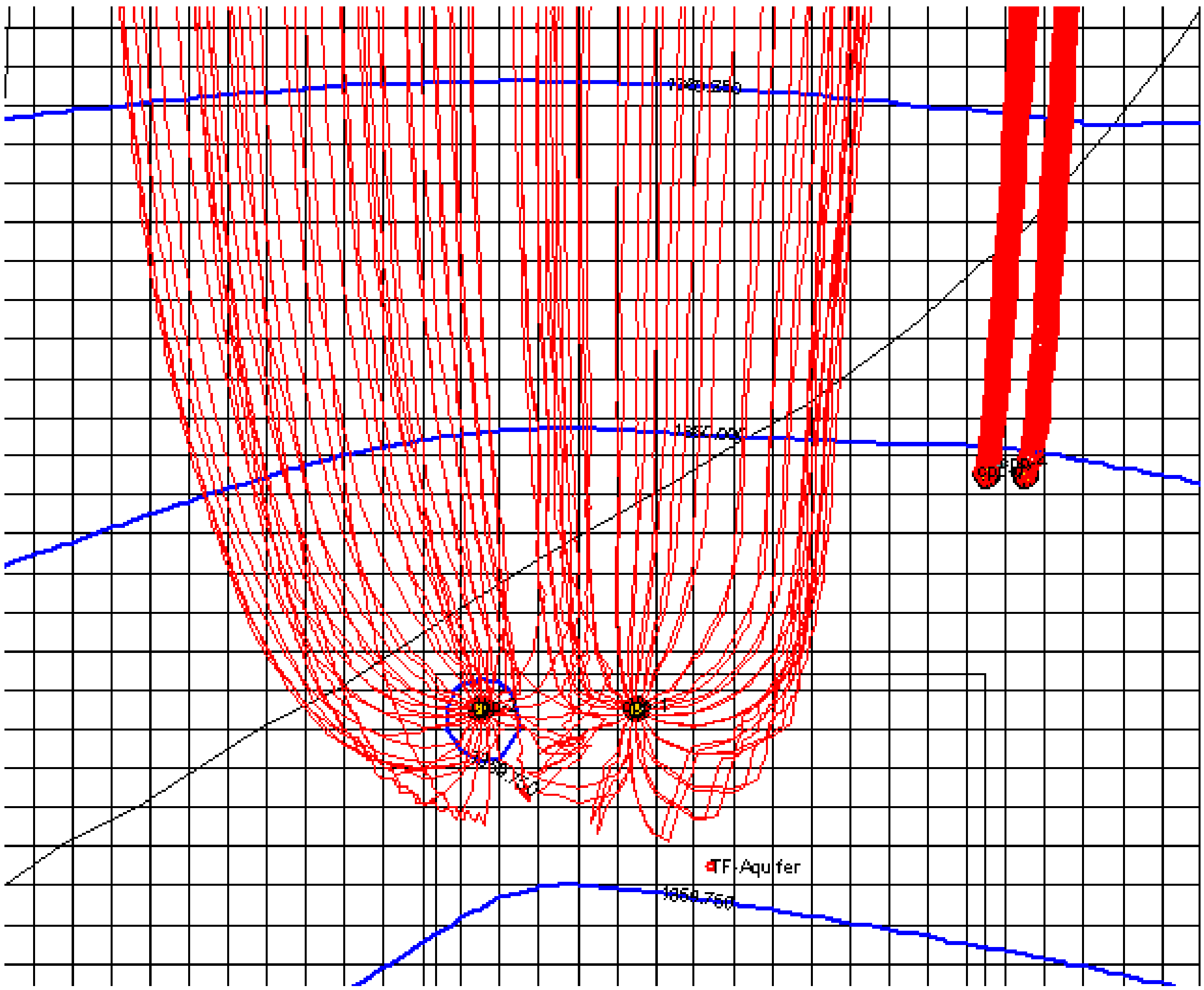


Figure F-12. Flow pathline plan view for 784 days of bimonthly alternating between Well CPP-1 and Well CPP-2.

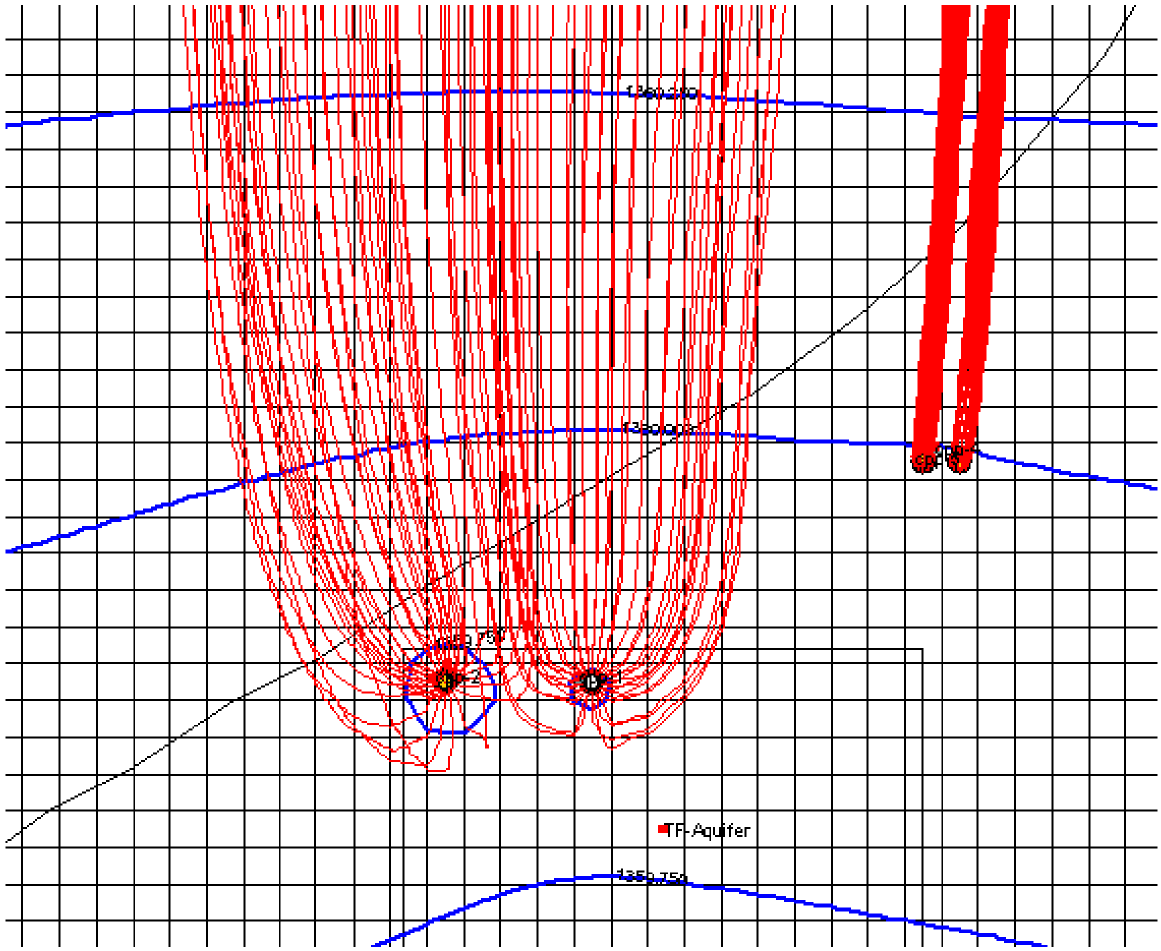


Figure F-13. Flow pathline plan view for 784 days of steady-state Well CPP-1 and Well CPP-2 production.

F-5. CONCLUSIONS

The relatively small production rate (approximately 68 m^3/day each) in potable water wells (CPP-4 and CPP-5) compared to the process water wells (CPP-1 and CPP-2) and large aquifer permeability results in the capture zones extending less than 20 m south of the well locations. Conversely, the process water wells' production rate (approximately 2,785 m^3/day each) results in a very large capture zone extending approximately 150 m south or 3/4 of the distance to the tank farm aquifer well.

Sampling of the two potable water wells was performed on August 18, 2003, after detection of the high Tc-99 in the tank farm well and Tc-99 was not detected. This confirms the simulations in this report that potable water wells have not been impacted by the tank farm contamination. The process water wells may be impacted by the contaminated water beneath the tank farm, if the recent high Tc-99 detections represent an area extending beyond approximately 40 m northwest of the tank farm aquifer well. However, mixing of the contaminated water with clean water in the large capture zone will most likely result in sufficient dilution to prevent production water from exceeding the MCL. Preliminary results of sampling of the process water production wells performed in October 2003 indicated Tc-99 is present in the process water, but the concentration is far below the MCL.

The process water production wells have the largest impact on aquifer gradient. The CPP-1 well steady-state drawdown is approximately 0.22 m and transient drawdown is approximately 0.37 m. The groundwater mounding resulting from the Big Lost River and other surface recharge sources are only a small fraction of this value and small compared to the large-scale gradient. The steady-state simulations with and without surface recharge indicated well capture zones are not significantly changed by the Big Lost River or INTEC facility recharge sources. The INTEC facility recharge did not include the relocated percolation ponds (the final recipient of the process water), which were relocated from the southern end of the INTEC facility to a new location approximately 2 miles west of the INTEC facility.

The twice-daily cycling of the CPP-1 or CPP-2 wells most likely does not have a significant impact on the simulated well capture zone. However, the bimonthly switching between CPP-1 and CPP-2 as the process water producer has a large impact on capture zone because the 2-week operation period affects a larger area of the aquifer than the daily cycling of each well during operation. The 2-week inactive period after each well's operation allows the drawdown around each to recover to ambient conditions.

It is important to note that the simulations presented in this report assume the fractured basalt aquifer beneath the INTEC behaves as an isotropic equivalent porous media and can be simulated as such. Flow is only considered in the basalt fractures and is assumed to behave as a low-porosity and high-permeability equivalent porous medium. The actual capture zones may be influenced by preferential flow paths due to rubble zones that occur near individual flow top and bottoms. These features may exist on the scale of meters in the vertical to hundreds of meters in the horizontal.

F-6. REFERENCES

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Appendix G

Tc-99 Sources at INTEC

Idaho National Engineering and Environmental Laboratory

INTEROFFICE MEMORANDUM

Home of Science and Engineering Solutions

Date:	September 1, 2004		
To:	J. R. Forbes	MS 3419	6-9685
From:	M. C. Swenson M C Swenson	MS 3404	6-3576
Subject:	SOURCE OF ELEVATED TC-99 ACTIVITY IN ICPP-MON-A-230 MONITORING WELL		

Summary

The aquifer beneath the Idaho Nuclear Technology and Engineering Center (INTEC) is contaminated with small quantities of radionuclides. Most of the contamination came from the historical disposal of slightly contaminated PEW Evaporator condensate to the service waste system. The service waste was sent to the aquifer via an injection well (and later, two percolation ponds). PEW Evaporator condensate is no longer sent to service waste, but the contamination remains in the aquifer from the past practice. Several monitoring wells have been installed in and around INTEC to monitor the contamination levels in the aquifer. A recent sample from a new monitoring well, ICPP-MON-A-230, contained tritium (H-3) and iodine (I-129) activity similar to that of other wells. However, well ICPP-MON-A-230 contained significantly more technetium (Tc-99) activity than other monitoring wells. The Tc-99 activity in well ICPP-MON-A-230 was nearly two orders of magnitude above that of other monitoring wells and exceeded the drinking water standard.

The differences in the relative quantities of radionuclides in well ICPP-MON-A-230 from those of other wells suggest its contamination came from a different source than the other wells. An evaluation of possible sources of contamination in well ICPP-MON-A-230 was performed. Well ICPP-MON-A-230 is located about 300 feet north of the INTEC Tank Farm where leaks from waste transfer piping contaminated the soil. This report evaluates the possibility that historical leaks from Tank Farm piping are the primary source of the contamination and elevated Tc-99 activity in well ICPP-MON-A-230. The relative quantities of H-3, Tc-99, and nitrate in well ICPP-MON-A-230 are close to those in the waste that leaked into the soil from Tank Farm piping in the late 1960s and early 1970s. The relative amounts of H-3, Tc-99, and nitrate in well ICPP-MON-A-230 do not correlate with the composition of the PEW Evaporator condensate and service waste that were sent to the aquifer via the injection well. Based on the relative amounts of the contaminants, historical Tank Farm piping leaks are a more likely source of the contamination in well ICPP-MON-A-230 than the service waste discharges. Details of the analysis leading to this conclusion are attached.

INTEC Waste Processing and Aquifer Contamination Background

The Idaho National Engineering and Environmental Laboratory (INEEL) reprocessed spent nuclear fuel (SNF) from 1953 to 1992 using facilities located at the Idaho Nuclear Technology and Engineering Center (INTEC), formerly known as the Idaho Chemical Processing Plant (ICPP). Historically, SNF was brought to INTEC from a variety of reactors throughout the world and stored for an interim period. Some of the SNF was chemically reprocessed to recover highly enriched uranium and other nuclear products for the Department of Energy and its predecessor organizations. SNF reprocessing produced liquid radioactive waste, which was stored in the Tank Farm. Most of the liquid waste was removed from the Tank Farm and solidified using a process called calcination. The granular solids from this process, called calcine, are stored in stainless steel storage bins contained in concrete vaults.

Although the bulk of the radioactive constituents associated with SNF reprocessing went to the Tank Farm and calcine solids storage facilities, trace quantities were released. Some of the released material contaminated the aquifer beneath INTEC. There are numerous wells in and around INTEC that are used to monitor the contamination in the aquifer. In May 2003 a sample was obtained from a new well (ICPP-MON-A-230) located about 300 feet north of the INTEC Tank Farm. The sample from well ICPP-MON-A-230 contained approximately the same amount of tritium (H-3) and iodine (I-129) as other INTEC wells. However, the sample contained significantly more (nearly two orders of magnitude higher) technetium (Tc-99) than other INTEC monitoring wells. The water in well ICPP-MON-A-230 was resampled and reanalyzed to assure the radionuclide data were valid.

Most of the radionuclides in the aquifer came from the historical disposal of slightly contaminated PEW Evaporator condensate via the service waste injection well. However, because the relative quantities of radionuclides in well ICPP-MON-A-230 differed so much from those of other wells, an evaluation was performed to determine if the contamination in well ICPP-MON-A-230 came from a different source. Another possible source of aquifer contamination is the material that leaked to the environment from waste transfer piping. There have been several radioactive waste leaks during the history of INTEC. Two leaks that occurred in the Tank Farm in the late 1960s and early 1970s contributed the bulk of the activity inadvertently released to the environment. Those two leaks are also located close to well ICPP-MON-A-230. This report evaluates the Tank Farm piping leaks and the PEW Evaporator condensate as possible sources of the contamination in well ICPP-MON-A-230.

Contamination in Well ICPP-MON-A-230

There have been many analyses of the water in the aquifer beneath INTEC from a variety of monitoring wells. Table 1 shows typical results for H-3, Tc-99, and I-129 from a few wells in 2001 and 2003 as reported in References 1 and 2. Wells # 47 and 57 have H-3, Tc-99 and I-129 activity typical of most INTEC monitoring wells. Data from well ICPP-MON-A-230 are also included on Table 1, though it has data only for 2003 because it is a new well. The H-3 and I-129 activity in well ICPP-MON-A-230 is similar to that of the other wells. However, the Tc-99 activity in well ICPP-MON-A-230 is nearly two orders of magnitude higher than that of other wells.

Table 1. Activities of H-3, Tc-99, and I-129 in selected INTEC aquifer monitoring wells.

Well #	H-3 (pCi/L)		Tc-99 (pCi/L)		I-129 (pCi/L)	
	2001	2003	2001	2003	2001	2003
USGS-47	3890	2560	38.3	42.5	0.75	0.46
USGS-57	5110	5450	38.8	51.4	0.57	0.51
ICPP-MON-A-230	NA	3700	NA	2220	NA	0.12

The radionuclide data in Table 1 are given in concentration units (activity per unit volume). The concentration of the radionuclides in the aquifer is much lower than the original waste source term due to dispersion of the contamination in the environment. However, if one assumes H-3, Tc-99, and I-129 are highly mobile and move freely through the environment without significant interaction with the soil, the relative amounts of these species in the aquifer should be the same as that in the original waste source. Table 2 contains relative (ratio) radionuclide data for a number of wells around INTEC for 2001 and 2003, including well ICPP-MON-A-230.

Table 2. Activity ratios of selected radionuclides in INTEC aquifer wells*.

Well #	H-3/Tc-99 ratio		H-3/I-129 ratio		Tc-99/I-129 ratio	
	2001	2003	2,001	2003	2001	2003
USGS-48	38	46	NA	11,290	NA	245
USGS-47	102	60	5187	5565	51	92
USGS-57	132	106	8,965	10,686	68	101
USGS-112	200	95	NA	NA	NA	NA
USGS-123	79	116	11,688	21,028	148	181
USGS-67	231	223	10,926	20,194	47	91
Average of 6 USGS Wells	130	108	9191	13,753	79	142
ICPP-MON-A-230	NA	1.7	NA	30,833	NA	18,500

Note: NA is given in well ICPP-MON-A-230 in 2001 because it is a new well and there are no 2001 data. For other cells, the NA is because the I-129 was below the analytical method detection limit.

A review of the data in Table 2 shows the average H-3/Tc-99 ratio in most wells to be about 100, while that in well 230 is about 1, two orders of magnitude lower than most wells. This is the result of the elevated Tc-99 value in well ICPP-MON-A-230 (see Table 1). Similarly, the Tc-99/I-129 ratio of well ICPP-MON-A-230 is nearly 20,000, two orders of magnitude above the value of about 100 in other wells. The H-3/I-129 ratio of 30,000 in well ICPP-MON-A-230, though higher than the value of 10,000 in other wells, is within the same order of magnitude as that of the other wells.

Historical Aquifer Contamination by the PEW Evaporator

The PEW Evaporator was the major source of the contamination in the aquifer. When reprocessing SNF, the PEW Evaporator treated large quantities (over 1 million gallons per year) of waste that was too dilute to send to the Tank Farm, but too contaminated for environmental disposal. The primary sources of waste to the PEW Evaporator were decontamination processes, ion exchange regeneration, water from contaminated cells and vaults, and other similar dilute wastes. The PEW Evaporator feed solution could be characterized as a small volume of concentrated waste mixed with a large volume of water. The feed solution to the PEW Evaporator generally had the same relative ratios of fission products as the Tank Farm waste, but in significantly lower quantities.

The output from the PEW Evaporator consisted of two streams; a large volume of very slightly contaminated water, and a small volume of concentrated and highly contaminated waste that contained most of the activity in the PEW Evaporator feed solution. The PEW Evaporator boiled most of the water in the feed solution and then condensed it. The condensate was the large volume of slightly contaminated water. It was referred to as "overheads" or "process condensate". Because most of the contamination in the Evaporator feed solution was not volatile, the process condensate was only slightly contaminated. Historically, the process condensate was sampled, verified to meet disposal criteria for radioactivity, and sent to service waste. The service waste transported the slightly contaminated PEW Evaporator condensate into the aquifer via the injection well. That disposal path no longer exists. Currently, the Liquid Effluent Treatment and Disposal (LET&D) treats the PEW

Evaporator condensate and disposes it to the atmosphere as a gas via the main INTEC stack (CPP-708). The small volume of concentrated Evaporator waste was called the "bottoms". The bottoms contained the bulk of the radionuclides in the Evaporator feed solution. The bottoms were sent to the Tank Farm for storage.

The PEW Evaporator is one of the INTEC processes in which radionuclide separation occurs. Most of the radionuclides in the Evaporator feed, such as Cs-137 and Sr-90, do not volatilize in the Evaporator. Those radionuclides concentrate in the Evaporator bottoms. However, a few radionuclides, such as H-3 and I-129, are volatile in the Evaporator. The bulk of the H-3 and I-129 in the Evaporator feed solution passes through the Evaporator to the overhead stream. The differences in radionuclide volatility results in very different relative amounts of some radionuclides in the Evaporator overheads compared with those in the original feed solution, bottoms, and Tank Farm. It is the differences in the relative amounts of radionuclides that make it possible to identify different sources for various aquifer well samples.

Historical Tank Farm Waste

Fuel reprocessing activities produced two general categories of Tank Farm wastes; first-cycle raffinate and sodium-bearing waste (SBW). First-cycle waste was produced by the dissolution of SNF and the recovery of uranium. First cycle waste contained the bulk of the radioactive constituents in the SNF and had the highest radionuclide activity of any INTEC liquid waste. SBW came from several sources including the uranium purification process (often called second and third cycle waste) and from incidental activities such as equipment decontamination associated with operation of the INTEC (including the PEW Evaporator bottoms). The name "sodium bearing waste" came from the waste's high concentration (1 to 2 Molar) of sodium ion. The high sodium content was the result of activities that made extensive use of sodium-based chemicals such as sodium hydroxide and sodium carbonate. Typically, the radionuclide content of SBW was much lower (an order of magnitude) than HLW.

The chemical and radionuclide content of the Tank Farm waste has been determined by a combination of sample analyses and calculations. Radionuclides that could not be measured in the waste were calculated based on fuel characteristics, burn-up time, cooling time, etc. Table 3 contains order-of-magnitude data for two INTEC wastes that could be sources of aquifer contamination. Table 3 includes PEW Evaporator condensate that was sent to the injection well via the service waste system, and first-cycle raffinate that leaked from Tank Farm piping. The relative quantities of the nuclides are approximate and vary with the type and age of waste. The radionuclide activity decreases with time due to radioactive decay. The nuclides in Table 3 have half-lives ranging from 12.3 years for H-3 to nearly 16 million years for I-129. The data in Table 3 are typical of waste generated in the early 1970s with the activity decayed to the present time. The data for the activity in the PEW Evaporator condensate come from References 3 and 4 except for that of Tc-99. There are no historical data for Tc-99 in the PEW Evaporator condensate and service waste. The Tc-99 value was estimated assuming the bulk of the H-3 and Tc-99 in the aquifer came from the PEW Evaporator condensate and were present in the condensate in the same relative quantities as in the aquifer. Currently, the ratio of H-3:Tc-99 in the average aquifer well is about 100. At the time of Evaporator condensate disposal, an average of 20 years ago, the ratio would have been about 300, so the amount of Tc-99 was likely 1/300 that of the H-3 at the time of disposal.

Table 3. Relative radionuclide activities of INTEC first-cycle waste and PEW Evaporator condensate.

Radionuclide	Relative Activity in Tank Farm Waste (Ci)	Relative Activity in PEW Evaporator Condensate (Ci)
Cs-137	10,000,000	1
Sr-90	10,000,000	1
H-3	10,000	1,000
Tc-99	1,000	10
I-129	1	0.1

Table 3 shows the significant differences between the relative radionuclide activities in the Tank Farm waste and the PEW Evaporator condensate. The PEW Evaporator condensate is relatively rich in H-3 and I-129 compared to the Tank Farm waste because those nuclides are volatile in the PEW Evaporator and go with the process condensate. The Evaporator condensate is depleted in Cs-137 and Sr-90 compared to the Tank Farm waste, because those nuclides concentrate in the PEW Evaporator bottoms. The amount of Tc-99 in the Evaporator condensate is reduced in comparison to H-3 and I-129. This agrees with studies (Reference 5) that conclude Tc-99 is not highly volatile in the PEW Evaporator process. Although Tc-99 does not appear to be as volatile as H-3 or I-129, Table 3 data suggests it is more volatile than Cs-137 or Sr-90.

Table 3 indicates the Tank Farm waste is enriched in Tc-99 compared to service waste. Since the water from well ICPP-MON-A-230 was enriched in Tc-99 compared to other INTEC wells, Tank Farm leaks were evaluated as the potential source of contamination to well ICPP-MON-A-230.

Historical Tank Farm Leaks

A logical source of the contamination in well ICPP-MON-A-230 is one having a large source term near the location of the monitoring well. Contamination levels in the aquifer will be less than the original source term as rainwater and snowmelt disperse the contamination and carry it to the aquifer. Contamination from small leaks, dilute waste, or leaks far from the monitoring well will likely have no significant effect on the activity in well ICPP-MON-A-230. There are two contamination sources at INTEC that have high activity and are located near well ICPP-MON-A-230. These contamination sources were leaks from Tank Farm piping that occurred in the late 1960s and early 1970s. Both leaks were discovered several years after they occurred. Therefore, remediation efforts such as soil removal and surface coverings likely had little effect on highly mobile nuclides such as H-3, Tc-99 and I-129. The mobile radionuclides were likely flushed from the original contamination site by rainfall, snowmelt, utility system leaks, etc. before remediation occurred.

The first potential contamination source is leak from a hole drilled into a waste transfer pipe during the installation of the encasement around the transfer pipe in the 1950s (Reference 6). The leak contaminated an area designated CPP-28 on current INTEC contaminated soil maps. The leak occurred in an area just south of the WM-181 tank. The leak was discovered in October 1974. Although the hole in the primary waste transfer piping existed for nearly 20 years, the secondary containment likely prevented any loss of activity and soil contamination for a number of years. The soil contamination likely occurred in the late 1960s and early 1970s. This is supported by the fact that the amount of soil contamination was not extensive, and the soil contamination included significant quantities of short-lived radionuclides. The leak investigation report (Reference 6) estimated 120 gallons of waste containing 6000 Ci of activity leaked into the soil. The type of waste that leaked was first cycle raffinate. This leak was a relatively small volume of waste with very high activity.

The second potential contamination source is a leak that occurred in November 1972 when the contents of WM-181 were transferred to WM-180. The leak was discovered in September 1975, approximately three years after it occurred. The leak occurred when a valve on a junction line with the main transfer route leaked, allowing acidic waste into a section of line that was not constructed of stainless steel. The non-stainless section of line corroded, allowing waste to leak into the ground. The leak occurred in an area immediately south of WM-183 and is designated CPP-31 on current INTEC contaminated soil maps. The report of the discovery and investigation of the leak (Reference 7) estimated 14,000 gallons of waste containing 28,000 Ci of activity leaked into the soil. This leak was 100 times larger in volume than the first leak, but had only about four times the activity of the first leak. This is because the second leak was SBW, which had a significantly less activity than first-cycle waste.

Other leaks occurred in the Tank Farm area, but they were not included in this analysis. Most of the other leaks were small, involving only a few gallons of waste. The amount of activity released to the ground from such leaks was insignificant compared to the two leaks discussed. The next largest leak was a leak on the east side of CPP-604 involving a waste transfer line from the WCF. A total of 1000 to 3000 Curies of activity was estimated to have leaked in that area (Reference 8). A 2000 Ci leak (midpoint of the estimated range) represents only 6% of the 34,000 Ci of the two combined leaks associated with contaminated areas CPP-28 and –31. The amounts and activities of the waste that leaked at CPP-28 and –31 are not precisely known. The amount of error in estimating those two leaks is larger than the leak east of CPP-604. Therefore, in additive terms, the other Tank Farm area leaks are negligible compared to the two leaks discussed in this report. In terms of waste characteristics, the source terms of the other Tank Farm leaks would be similar to the two leaks discussed.

In addition to the data for H-3, Tc-99, and I-129, there are also data for non-radioactive components in the Tank Farm waste, service waste, and well contaminants that can be used to help determine the source of contamination in the aquifer. One of the significant components of both Tank Farm waste and PEW Evaporator condensate is nitrate (NO_3). Nitrate does not form precipitates or otherwise react with the soil, is mobile in the ground, and was detected in quantities significantly above background in the well ICPP-MON-A-230. The nitrate concentration in well ICPP-MON-A-230 was approximately 40 mg/L, or 10 mg/L expressed as NO_3-N (References 9 and 10). The nitrate concentration in most aquifer monitoring wells and in the INTEC production wells is approximately 10 mg/L (2.5 mg/L NO_3-N). Nitrate levels in "clean" groundwater (upstream of any INTEC contamination) are 4 mg/L or less.

Nitrate is present in high concentrations in Tank Farm waste. For example, the nitrate was 4.38 molar (272 g/L) in the SBW that contaminated CPP-31. There is also nitrate in the PEW Evaporator system. However, because nitrate is semivolatile, partitioning of nitrate occurs in the Evaporator, similar to that of some radionuclides. Consequently, the nitrate concentration in the PEW evaporator condensate is lower than the bottoms and Tank Farm waste, typically about an order of magnitude. This makes the Tank Farm waste enriched in nitrate compared to PEW Evaporator condensate and the service waste stream.

Nitrate was the only non-radioactive constituent for which well and waste source data were compared. Some of the other non-radioactive waste constituents react with the soil. Some constituents are present in such small quantities that they would be below background levels in the aquifer. Some aquifer contaminants could have additional sources (such as sodium and chloride coming from salt that was widely used around INTEC) that could make it difficult to identify a single source term. Because of these reasons, nitrate was the only non-radioactive contaminant for which well contamination and source term comparisons were made.

Evaluation of Sources of Contamination in Well ICPP-MON-A-230

The composition of the waste from the two previously described Tank Farm leaks was estimated and decayed to the present time in order to be able to compare the radionuclides in the waste that leaked with those found in well ICPP-MON-A-230. The two Tank Farm leaks were located in close proximity to each other and occurred about the same time. The aquifer would likely see those two leaks as a single contamination source. Therefore, this analysis combined them into a common source term. The data for the Tank Farm leaks, well ICPP-MON-A-230, and an "average" INTEC monitoring well were then manipulated to obtain relative activities and quantities of contaminants. This was done by calculating ratios of the Tank Farm waste components with contaminants in the wells. The results are shown in Table 4.

Table 4. Comparison of contaminants in aquifer wells with constituents of Tank Farm waste.

	Well ICPP-MON-A-230	Combined CPP-28 and –31 Tank Farm leaks	Average Aquifer Well*
H-3/Tc-99 ratio	1.7	2.2	100
NO_3/H-3 ratio (g/microCi)	9.7	4.7	0.1
NO_3/Tc-99 ratio (g/microCi)	16.2	10	100
NO_3/I-129 ratio (g/nanoCi)	300	11	3
Tc-99/I-129 ratio	18,500	1100	100
H-3/I-129 ratio	30,800	2400	10,000

*Average of six USGS wells shown in Table 2

The first three lines of data in Table 4 show an excellent correlation between the H-3, Tc-99, and NO_3 in well ICPP-MON-A-230 and the Tank Farm waste that leaked. The relative amounts (ratios) of H-3, Tc-99, and NO3 in the Tank Farm are within a factor of two with those in well ICPP-MON-A-230. In contrast, the relative amounts of those three contaminants in the average aquifer well (which have the same relative quantities as the PEW Evaporator and service waste) differ by as much as two orders of magnitude from the amounts in well ICPP-MON-A-230.

Table 4 shows the ratios involving I-129 are inconsistent and do not closely correspond with either the Tank Farm waste or the contaminants in other well. The Tc-99/I-129 and the NO_3/I-129 ratios in well ICPP-MON-A-230 are closer to the Tank Farm waste than the average well, but the H-3/I-129 ratio in well ICPP-MON-A-230 is closer to that of the service waste and average well. However, there is not a close relationship in any of the ratios involving I-129.

There are two potential reasons for the discrepancies with the I-129 ratios. One reason is the I-129 activity in the Tank Farm source term is overestimated. Using too large a value for the Tank Farm source term would reduce the ratios involving I-129 in Table 4. The Tank Farm source term is based on historical sample analyses and theoretical calculations (Reference 11). Reference 11 reduced the H-3 content of SBW (the largest portion of the Tank Farm source term) by 86% from its theoretical value based on samples of SBW. The PEW Evaporator bottoms are a significant source of the SBW. Most of the H-3 in the PEW Evaporator went to the overheads, producing H-3 depleted bottoms. Based on service waste samples, H-3 and I-129 were lost in approximately equal relative amounts to the PEW Evaporator overheads. Therefore the PEW Evaporator bottoms (and SBW) should be depleted in I-129 in an amount equal to that of H-3. However, Reference 11 made no reduction to the theoretical value of I-129 in SBW. This was because there weren't any reliable I-129 analyses from which to make a defensible reduction in I-129. The I-129 used for the SBW source term was based on a SBW sample. It was lower than that predicted by Reference 11, but not as low as the 86% reduction used by Reference 11 for the H-3. The I-129 in the first-cycle Tank Farm waste is also overestimated. Studies (Reference 12) show some (15%) I-129 is lost from the first cycle waste before being sent to the Tank Farm. Reference 11 does not include this loss in its source term. The result is the I-129 in the Tank Farm waste was overestimated, resulting in too low ratios for the Tank Farm leaks in Table 4.

Another reason for inconsistent I-129 ratios in Table 4 is there is evidence that I-129, though highly mobile, is not quite as mobile as H-3, Tc-99, and nitrate. Reference 13 contains sorption coefficients (K_d) for several elements (including iodine and technetium) in various types of soils. In general the sorption coefficient for technetium in a given type of soil is lower than that of iodine. Because of its higher sorption coefficient, some I-129 retardation in the soil/basalt may occur. This would yield low I-129 activity in the aquifer samples, compared to those of the other mobile contaminants. This could explain the data in Table 4 in which the I-129 in well ICPP-MON-A-230 appears to be too low.

Conclusion

Samples from a new aquifer well, ICPP-MON-A-230, have elevated Tc-99 activity compared to other aquifer monitoring wells. The activity of H-3 and I-129 in well ICPP-MON-A-230 is similar to those in other aquifer monitoring wells. The Tc-99 activity in well ICPP-MON-A-230 was confirmed with multiple samples and independent laboratory analyses. One possible explanation for the elevated Tc-99 activity in well ICPP-MON-A-230 is the contamination came from a different source than the contamination in the other aquifer wells. Most of the contamination in the aquifer originated with the PEW Evaporator overheads that were historically combined with the INTEC service waste stream and disposed to the injection well. However, historical leaks from Tank Farm piping could also be a source of contamination to the aquifer. The relative amounts of contaminants in the Tank Farm waste were significantly different from that of the PEW Evaporator condensate and service waste. There is a close correlation between the H-3, Tc-99, and NO_3 content of two significant Tank Farm waste leaks that occurred in the late 1960s and early 1970s, and that in the samples from well ICPP-MON-A-230. The H-3, Tc-99, and NO3 content of well ICPP-MON-A-230 do not correlate with PEW Evaporator condensate and service waste composition. The correlation between the I-129 in the Tank Farm waste and well ICPP-MON-A-230 is less conclusive. However, the I-129 source term for the Tank Farm waste is likely lower than the estimated value and may contribute to some of the difference in the I-129 data. Additionally, there is evidence that the migration of I-129 may be retarded slightly in the ground which could also account for a low concentration in the aquifer well samples. Based on these data, the contamination in well ICPP-MON-A-230 more likely came from Tank Farm piping leaks that occurred in the late 1960s and early 1970s than the service waste and injection well system.

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